Railway Mechanical Engineer

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Alphabetical Index to Advertisements, Page 124 — Classified Directory of Advertisers, Page 116

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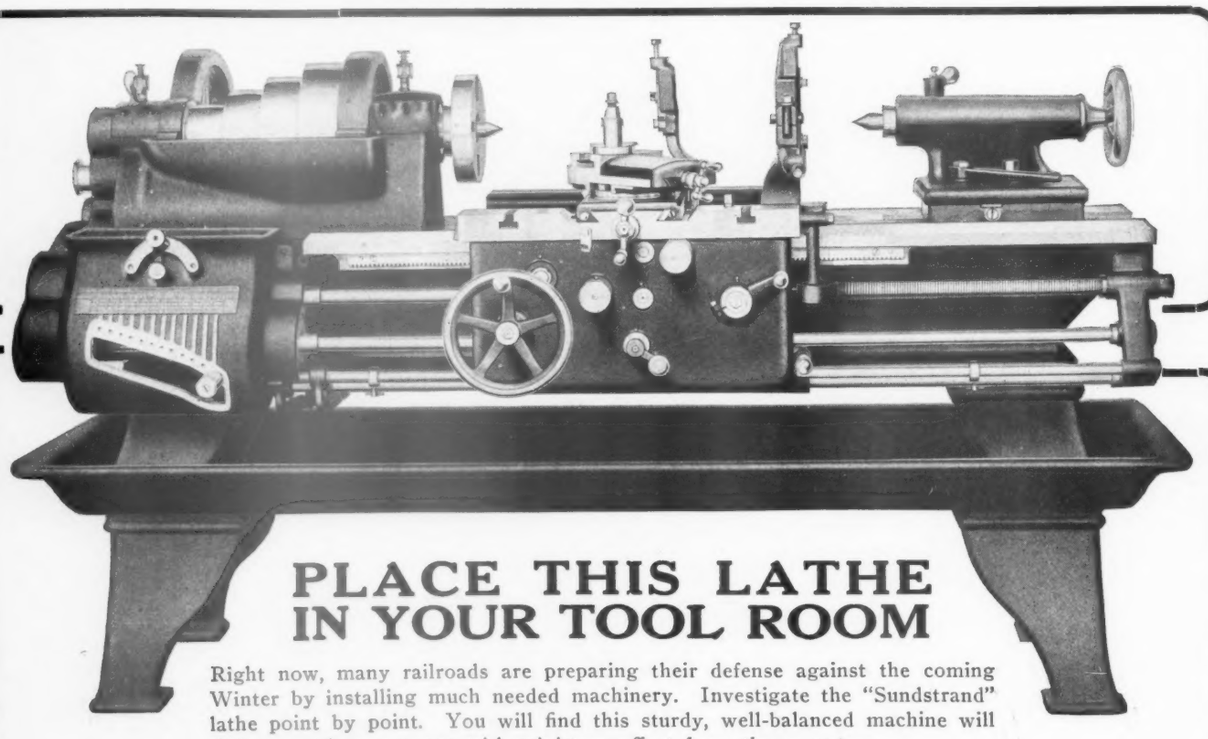

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Railway Mechanical Engineer

Volume 92 December, 1918 No. 12

CONTENTS

EDITORIALS:
- The Red Cross Christmas Roll Call 641
- Improve Air Brake Maintenance 641
- Why Retain Long Pilots on Locomotives? 642
- Uniform Engine Failure Reports 642
- Full Day's Work for Full Day's Pay 642
- Don't Overlook the Foremen 642
- Director-General McAdoo Resigns 643
- New Books 643

COMMUNICATIONS:
- Working Conditions of Mechanical Department Foremen 644
- The "Doughboy" and the Men Who Get the "Dough" 644

GENERAL:
- Locomotive Feed Water Heating 645
- A. T. & S. F. 4-8-2 Type Locomotives 649
- Superheater Locomotive Performance 652
- Railroad Administration News 655
- Radiant Heat and Firebox Design 658

CAR DEPARTMENT:
- Adapting Baker Heaters to Burn Soft Coal 661
- Piston Travel and Braking Power 662
- Standard U. S. R. A. Refrigerator Car 663
- Passenger Car Cleaning 668
- M. C. B. Circular on Air Brake Maintenance 669

SHOP PRACTICE:
- Billerica Reclamation Plant 671
- Accuracy in Locomotive Repairs 673
- Locomotive Air Brake Tester 677
- Soft Grinding Wheels 678
- Ted Symington—No Slacker 679
- Wedge Block for Jacking Locomotives 680
- Hydraulic Press for Shortening Drawbars 681
- Full Day's Work for a Full Day's Pay 681
- An Improvised Hydraulic Ram 682

NEW DEVICES:
- Hose Mounting and Hose Clamping Machine 683
- Inside Admission Piston Valve Chest for Slide Valve Cylinders 684
- Arc Welding Tool with Positive Electrode Clamp 685
- Milling Machine Vise 685

GENERAL NEWS:
- Notes 686
- Meetings and Conventions 688
- Personal Mention 688
- Supply Trade Notes 691
- Catalogues 692

THE ANNUAL INDEX

For the purpose of conserving paper, only a sufficient number of indexes for the 1918 *volume of the "Railway Mechanical Engineer" will be printed to meet direct requests from the subscribers. Those desiring indexes will therefore please send their requests on or before December 25 to the New York office,* 2201 *Woolworth Building.*

Improve Air Brake Maintenance

The manner in which the maintenance of air brakes has been neglected has necessitated the issuance of various circulars by the Railroad Administration and others, urging greater care in this matter. The most recent appeal is that from the Master Car Builders' Association, which urges a closer observation of the interchange rules and the standards of the association. This appeal is printed in full elsewhere in this issue, with rules covering maintenance of triple valves and brake cylinders. It is hard to understand why air brake maintenance should have been allowed to be neglected, for certainly the air brake is a most important feature in successful train operation. Upon it depends the safety with which trains may be operated, the despatch with which traffic can be carried, and to no small extent, the amount of fuel required to conduct transportation. There has been evidence of gross neglect of inspection and repairs at terminals. Cases have been reported where a reinspection of a train showed a decrease of over 10 per cent in the number of operative brakes in a train. This is not only against the law, but is nothing short of criminal neglect. Every effort must be made to bring conditions back to normal and at the earliest possible moment, for serious and expensive delays will result if this question is not given the attention it deserves.

The Red Cross Christmas Roll Call

It is unnecessary to call to the attention of our readers the remarkable work that has been done by the American Red Cross during the war. The Red Cross has always had the reputation of quickly getting to the scene of any great calamity and taking care of the sufferers. In pre-war times, the average person thought of the organization more in connection with hospital work than in any other capacity. During the great war, however, it has been active wherever there was suffering or need of help. Its work during the period of reconstruction promises to be as important, or even more important, than during actual warfare. Relief must be extended to those peoples that have been driven from their homes and who can now return to their native places and gradually re-establish themselves with the help that they may receive through the Red Cross. Then, too, the great problem must be faced of reclaiming those who have been injured and crippled. In the week beginning December 16, the American Red Cross is to hold a "Roll Call." This is not a drive for funds, but is rather an attempt to enlist every American, that is not now in the armed service of the United States, in becoming actively identified with the Red Cross movement which in the months to come will have to play a large part in the effort to repair the ravages and damages of the war and to supply the necessary aid to the thousands that may need it. The Red Cross needs the inter-

est and support of every red-blooded American and, on the other hand, every American citizen should feel honored in being identified with it.

Why Retain Long Pilots on Locomotives

The pilot is usually considered one of the unimportant parts of the locomotive and as a rule it receives but scant attention. An incident recently came to our notice that shows the necessity for giving some attention to the design of the pilot. On account of lack of space in the roundhouse a locomotive had been backed on a spur track. When it was to be put in the house it did not have steam enough to move. The pilot was so long that the switch engine which was to haul the locomotive out could not get it without bending the foot board, and it was necessary to make a trip to the yard, pick up a car, switch the locomotive into the house and set the car back in the yard. Inquiry developed that this awkward maneuver was of frequent occurrence.

In the early days of railroading in this country the pilot deserved the popular title of cowcatcher. Some roads still have trouble with live stock on the right of way but this is hardly sufficient reason for retaining the type of pilot used 50 years ago. Short pilots are as good if not better in clearing obstructions from the track. If the point of the pilot does not extend to the face of the coupler knuckle locomotives can be coupled with the pilots together, which is particularly desirable to facilitate handling on roundhouse tracks. Metal pilots are superior to wood as they can be made much stronger and if damaged usually require only to be straightened, while a wooden pilot which has met an obstruction is seldom worth repairing. The only explanation for the survival of the long wooden pilot seems to be adherence to custom. The short metal pilot is so obviously superior that it is hard to understand why its use has not become practically universal.

Uniform Engine Failure Reports

One important mission the Railroad Administration can perform before it passes out of existence is to formulate a code of rules to be used in the determination of engine failures and put it in force on all railroads under its jurisdiction. The chief purpose of the mechanical department is to provide adequate and well maintained equipment for carrying the traffic. The success with which it does this is measured by the amount of equipment kept in repair and the performance it gives on the road. In order to obtain an idea of the locomotive performance on two different roads, questions are asked frequently regarding the miles per engine failure. Under existing conditions this is highly misleading, for the definitions of engine failures and the degree of accuracy by which they are obtained are so much at variance that no fair comparison can be made. The Traveling Engineers' Association at its recent convention brought this point out clearly and its committee stated definitely what should constitute an engine failure. It recommended the following two definitions:

"1. All delays waiting for an engine at an initial terminal, except in cases where an engine must be turned and does not arrive in time to be despatched and cared for before leaving time.

"2. All delays on account of engines breaking down, running hot, not steaming well, or having to reduce tonnage on account of defective engine, making a delay at a terminal, a meeting point, a junction connection, or delaying other traffic."

These are supplemented by 13 items which should not be considered as engine failures, but which would not be needed if rule No. 2 were correctly interpreted. There are opportunities and temptations to charge an engine with a failure when the delay may be due entirely to other causes, such as mishandling on the part of the crew, either engineman or fireman, excessive tonnage, weather conditions, or any of a hundred possible causes, any of which may result in poor engine performance and for which the engine or its condition is least of all responsible. The Mechanical Department of the Railroad Administration has unified the classification of locomotive repairs; it likewise should establish uniform classification of engine failures and provide some fair method of reporting them to eliminate the possibility of unjust charges.

Full Day's Work for a Full Day's Pay

There are two articles in this month's issue that bring out conditions in the shop labor situation, that are of special interest at this time. George N. De Guire, general supervisor of equipment for the Division of Operation, in an address before the men at one of the important shops, which is abstracted on page 681 of this issue, discloses the fact that deplorable conditions have existed in some of the shops in the eastern territory. In the particular shop at which this address was made he finds the effects of unrestricted development of the labor organizations, for he says, "I thought the government took over this railroad sometime ago, but found that the employees, so far as this shop was concerned, were still running it." He cautions the men that the Railroad Administration will not stand for any such policy and says that, "Insubordination must cease, men must obey orders," and advises the shop management to get rid of the men in the shop who do not work the required number of hours, "For we cannot afford to tie up machines day after day waiting for some men who work only when they please." No shop can be efficiently managed where discipline does not obtain and discipline cannot be obtained unless the men realize that the penalty for insubordination is discharge.

On page 644 a correspondent writes of the "Doughboy" and the men who get the "dough!" He sounds a warning of what may happen to the shop man who "has just been drifting along in a 'don't care' sort of way" when the "Doughboys" come home and are looking for a job. The old, old law of supply and demand is still in operation and can never be annulled. With mechanics and laborers released from war work, and the soldier coming back to civil life, the man who does not give a full day's work for a full day's pay had better watch out.

Don't Overlook the Foremen

In the short period of 10 months in which the Railroad Administration has been free to develop and carry out its own policies, it has accomplished much that is admirable in dealing with the problem of wages and working conditions of railroad employees. It has secured justice for many groups whose claims have heretofore received comparatively little attention. There has been a tendency, however, to overlook the case of the salaried foremen and supervising officers of the mechanical department shops, repair yards and roundhouses. These men have long been underpaid and in addition to carrying the burden of responsibility incident to getting results with poor or indifferent facilities, have been required to be on the job many more hours than the forces which they supervise. No general leveling up of wages furnishes adequate remedy for this situation; unfortunately, many of the relative adjustments of compensation, and the general adoption of the basic eight-hour day and punitive overtime which have followed the general wage increase effected by General Order No. 27 and Supplement No. 4, have served to increase the disparity between their conditions and those of the men under their supervision. Attention is drawn to this situation by a corre-

spondent in a letter appearing on another page, in which he refers to a national organization of foremen recently formed, for the purpose of better presenting their claims to the Railroad Administration.

These men must not be overlooked. Although they do not constitute a large class, the effectiveness of the efforts of all the mechanical department forces depends in a large measure upon the ability, foresight and enthusiasm they bring to their tasks. If the exercise of these qualities is to be secured in full measure and the right material secured for the future, they must be accorded equal consideration with the wage earners.

Just what effect recent events will have on the policy of the Railroad Administration it is impossible to say and what will be the ultimate disposition of the agencies it has created is beyond conjecture. But it has the opportunity of performing a permanent service, long needed, for the welfare of the mechanical department by properly adjusting the relation of the conditions of employment of the foremen to those of the men who are now so well cared for.

Director General McAdoo Resigns

On November 22 Director General McAdoo tendered his resignation to President Wilson, to take effect January 1, 1919. During the slightly less than 11 months of government control of the railways Mr. McAdoo has wrought some extraordinary changes in railroad conditions and to an extent which will make it exceedingly difficult to return the roads to their private owners in the condition in which they were prior to being taken over by the government. Unfettered by binding federal laws, by the Interstate Commerce Commission and by the various state commissions, all of which have seriously hampered proper development of the railroads in the past, he has pooled facilities, completely rearranged traffic, and increased freight and passenger rates. This unlimited power has made possible the handling of a greater amount of traffic than was ever before handled by the railroads under private management, with but very little increase in facilities. This has been done, however, with an enormous increase in expense, primarily due to the increases in wages, which it is estimated will be between $600,000,000 and $800,000,000 for the year. Having done these things, which were impossible under private management and which will be impossible under future private management unless conditions change radically, it is plain to be seen that a sudden release of the railways to their private owners would result in grave consequences.

The problem is exceedingly complicated. The President admitted it in his discussion of the railroad problem before Congress on Monday, December 2. He says, "It is a problem which must be studied, studied immediately and studied without bias or prejudice." He has no suggestion for a solution. He points out three alternative courses, which in effect are: First, to release the roads and permit them to go back to the old conditions of private management; second, establish complete government control with actual ownership if necessary; or, third, to adopt an intermediate course of modified private control under which wasteful competition will be avoided and a certain degree of unification obtained, "as for example, by regional corporations under which the railways of definable areas would be in effect combined in single systems." He has placed the entire matter in the hands of Congress.

The clamor for actual government ownership is not now as great as during the early part of the year. To what extent this is due to the election of a Republican Congress, to the sentiments expressed against government ownership by the state commissioners at the convention in Washington, and to the resolution passed by the Industrial Traffic League, is hard to determine. The American railroads, the greatest in the world, have been built up under private ownership and no other system holds out the same incentive to improve service, and to develop economies in operation. If the history of railroads operated under government control in other countries is any criterion, the railroads in this country would never have been developed as they have been if competition had been throttled by government control.

The heads of the railways have already begun to consider the problem. Representatives of 90 per cent of the railroads in the United States met on December 4 and defined desirable government regulation as that which "will provide unification of regulation in essential matters, insure business treatment of the vast interests involved, attract adequate capital and assure commercial, manufacturing and agricultural interests of the country transportation facilities which shall keep pace with their growing interests, and deal equitably with questions affecting wages and the working conditions of railroad employees."

What is to be done with the railways is one of the most important questions before this nation in its reconstruction plans. The matter is in the hands of Congress, the representatives of the people, and therefore in the hands of the people, and Congress must be guided by the will of the people.

NEW BOOKS

Economical Use of Coal in Locomotives. Prepared by the University of Illinois under the direction of a special committee, 71 pages, illustrated, 6 in. by 9 in., bound in paper. Published by the University of Illinois, Urbana, Ill., as Engineering Experiment Station Circular No. 8. Price 20 cents.

The Engineering Experiment Station of the University of Illinois has undertaken to prepare for users of fuel certain publications containing suggestions and advice relating to fuel conservation. The present circular has the purpose of helping railway officials and employees in their efforts to save coal. While it contains little that is new, it presents a simple statement of the facts concerning the choice, distribution, storage, and use of coal, and offers some conservative suggestions concerning the ways in which coal may be burned economically. The saving of a piece of coal the size of an ordinary egg on each scoopful of coal used in locomotives would amount to 1,500,000 tons a year. Even when firing a freight locomotive on a heavy grade, one less scoopful of coal every fifteen minutes, or one less scoopful every three or four miles, would effect a similar saving. A little more personal interest on the part of railway officials and employees will reduce coal consumption even on railroads where the practice is already excellent and where an earnest effort is being expended to save coal. A study of the practice in the use of fuel on the railways, however, discloses many means of effecting even greater economy. Colored illustrations are included in the pamphlet to show results of good and bad methods of firing. A clear discussion is given of the heat and coal distribution throughout the locomotive which is illustrated by well designed charts and pictures. The facts presented in this circular have been compiled by a special committee of the research staff of the Engineering Experiment Station, assisted by an advisory committee consisting of E. W. Pratt, assistant superintendent of motive power, Chicago and Northwestern; W. L. Robinson, fuel supervisor, Baltimore and Ohio; A. N. Willsie, chairman, fuel committee, Chicago, Burlington and Quincy; Timothy Shea, acting president, Brotherhood of Locomotive Firemen and Enginemen; A. B. Garretson, president, Order of Railway Conductors of America; W. S. Stone, grand chief, Brotherhood of Locomotive Engineers; O. P. Hood, chief mechanical engineer on Fuel Conservation, U. S. Fuel Administration, and C. F. Richards, dean of the College of Engineering and director of the Engineering Experiment Station, University of Illinois.

COMMUNICATIONS

WORKING CONDITIONS OF MECHANICAL DEPARTMENT FOREMEN

Albuquerque, N. Mex.

To the Editor:

Just a word of thanks from railroad supervisory forces for the stand taken by your journal in support of adequate compensation for men on the railroads of the United States engaged in supervisory capacities.

There are organizations of the various branches of railroad employees, who have had representatives in Washington engaged in an earnest effort to have salaries raised for members of their respective branches. All have been represented except the foreman, general foreman, general inspectors and their respective assistants in the mechanical departments. All have received substantial concessions as to working conditions and salaries except those just enumerated. In order to properly bring before the Railroad Administration the claims of mechanical department supervisory forces, an Association of Railroad Supervisory Foremen was organized at St. Louis, Mo., on October 30, 1918.

Due to the combined efforts of your journal, and small independent committees representing the foremen interested, the question of salaries is being gradually adjusted to an equitable basis. There are other glaring defects in the working conditions of mechanical department supervisory forces which also need investigation with a view to correction. One of these, and more vital than the question of salary, is the twenty-four-hour day, and thirty-day month which 95 per cent of these men are required to adhere to.

Placing the supervisory forces of the men not included in the crafts—the clerical forces, the bridge and building and water service forces—on a basic eight-hour day, has resulted in officers figuring out where an eight-hour day for these men will be sufficient, and also has eliminated unnecessary Sunday work. In approximately 95 per cent of the various railroad shops and roundhouses in the country, it is found that on every Sunday practically all the foremen are on duty from three to twelve hours. They are most always dressed in their "Sunday clothes," just "hanging around," waiting (under orders) for some possible contingency to arise. The entire organization does not perform enough duties collectively to keep one of them busy all day. On this account very few foremen have what could be called a Sunday to themselves, to do with as they wish, at any time during the year, except possibly at regular vacation periods of fourteen days once a year.

One or possibly two of the foremen could take care of all the business. If each foreman was designated to be on duty his respective Sunday, to act as general foreman for that day, to take charge of and be responsible for the entire plant, it is easily seen that the excessive amount of time on duty could be reduced without impairing the operation of the railroads in the least. For instance, where there is a general foreman and eight craft foremen it would be only necessary for each one of them to be on duty every ninth Sunday. The experience gained by the respective foremen would be invaluable to both the railroad and the men when a chance for promotion came.

To sum up the respective orders and supplements, allow all the immediate supervisory forces of the Railroad Administration a basic eight-hour day and twenty-six-day month, except those of the locomotive and car departments. Were the supervisory forces of these departments placed on an eight-hour basis, it would naturally follow that department officers would figure out how little overtime was necessary for these men to work in order to carry on the business. Now no attention is paid to the excessive number of hours on duty, and in some instances the monthly salaried men are expected to work more time in order to take the place of hourly rated assistant foremen.

As this is a vital question, and must come up for investigation, I hope you can give this communication space.

H. Louis Hahn,
Seventh Vice-president, International Association Supervisory Railroad Foremen.

THE "DOUGHBOY" AND THE MEN WHO GET THE "DOUGH"

Chicago, Ill.

To the Editor:

Perhaps no class of men has received better consideration by the Railroad Administration, in point of wage increases and hours of labor, than those who are employed in the car and locomotive departments. The government while prosecuting the war made every effort to satisfy labor at home, and at the same time make the employment attractive from a remunerative standpoint.

It was no doubt the intention of the director general to stimulate the workers to greater output to meet the emergencies that the war had thrust upon the United States. That the major portion of these men have worked steadily and put in many long hours is a fact, as evidenced by their pay checks, and that men from other fields of labor have been attracted to this particular branch of railroad service is also true. To these two reasons—increased wages and an extra amount of help—may we attribute the success of meeting in a measure the needs of the times.

Now that our army is being demobilized and millions of the soldier boys will in course of time return to useful occupations of a constructive nature, many changes will become quite noticeable, and the fellow who had just been drifting along in a "don't care" sort of way will soon begin to slip. Why? Because our soldier boys in their intensive training have become hardened and full of the American spirit—better known as "pep." They have learned to sleep outdoors—at night before they slept they have seen the stars in the sky, and at dawn as they awoke they have heard the birds sing. They have learned from bitter experiences just what camouflage is; there will be no deceiving these boys. Upon their return they are going to demand of us the highest degree of efficiency. This is a force to be reckoned with.

Qualification is going to be a big factor when this huge force of reconstruction gets back to work, and it behooves each individual in these and other departments to take full advantage of every opportunity in order to measure up to the full requirements of his position. Economy of time and how best to use it should prove an important lesson to all of us. "Dost thou love life? Then do not squander time, for that is the stuff life is made of."—Franklin.

Our soldier boys have not been idle, they have read much and studied hard, and have been trained to use weapons of destruction, but to be used only against the common enemy of mankind—those who would oppress. Now the victory has been won and after the bitter hardships and experiences of warfare they are to return, work with us and live among us. As they relate their many but varied experiences of the "Doughboy" life, it is quite possible that those who worked at home and received the "dough" may soon forget and even blush at the thought of any real or imaginary grievances, but on the other hand may we not all become inspired with their enthusiasm to turn in and do our bit in the reconstruction period now before us?

Emerson wrote: "Man's life is progress, not a station." Moral—Let us progress.

N. H. C.

LOCOMOTIVE FEED WATER HEATING

Discussion of the Exhaust Steam and Waste Gas Methods of Preheating for Locomotive Boilers

BY H. S. VINCENT

THERE are in the locomotive two sources of preheat available from which it is possible to derive economy, these are exhaust steam and waste gases. The former contains the greater quantity of heat and this heat is more readily transferred to the feed water, but as the exhaust jet is universally used for drafting the locomotive it is possible to divert only a limited amount of the steam for heating purposes. On the other hand from 20 to 45 per cent of the heat in the fuel escapes as waste gases through the smoke stack. This great loss would seem to offer a fertile field for economy, but on account of the slow rate of transfer between this heat and the feed water, as well as the practical difficulties in the way, little progress has been made in utilizing this waste.

It is the desire of the writer to point out the extent of the economies which may be realized from the preheating of feed water by the two systems mentioned as well as by a combination of these systems in series.

In order to present the matter in a way which may be readily understood the calculations have been based on an equipment suitable for application to a typical high speed passenger locomotive. The principal dimensions and characteristics of the locomotive selected are given herewith.

Cylinders diameter and stroke	27 in. by 28 in.
Driving wheels diameter	80 in.
Heating surface evaporative	4,036 sq. ft.
Grate area	69.2 sq. ft.
Boiler pressure	205 lb.
Tractive effort (85 per cent boiler pressure)	44,500 lb.
Weight on drivers	202,880 lb.
Weight total engine	309,140 lb.
Indicated hp., maximum	3,184
Boiler hp., A. S. M. E. ruling	2,534
Dry coal per sq. ft. grate, per hour max	170.5 lb.
Net cross sectional area, tubes and flues	1,321 sq. in.
Area exhaust nozzle	38.19 sq. in.

EXHAUST STEAM HEATING

Consider first the application to this engine of a feed water heater using a portion of the exhaust steam as the heating medium.

EFFECT ON THE NOZZLE AREA

The statement has been made that a portion of the exhaust steam may be diverted for heating the feed water without necessitating a reduction in the area of the exhaust nozzle. It can be demonstrated that this statement is not correct,

TABLE I

1 Dry coal per sq. ft. grate per hour	2 Steam to cyls. Lb. per hour	3 Effective draft, Ins. water	4 Pressure in exhaust passages	5 M	6 W	7 E
40	26,400	3.10	3.50	7.34	1,011	116,400
50	31,400	4.40	4 80	8.72	1,136	173,800
60	36,300	5.75	6.20	10.09	1,220	233,100
70	40,150	7.00	7.60	11.15	1,270	279,200
80	43.800	8.15	8.95	12.15	1,313	325,500
90	46,800	9.20	10.15	13.00	1,342	364,000
100	49,500	10.10	11.30	13.75	1,361	396,000
110	52,000	10.95	12.30	14.43	1,373	422,000
120	54,400	11.80	13.70	15.10	1,381	448,000
130	56,600	12.60	14.60	15.70	1,387	469,800
140	58,800	13.40	15.75	16.32	1,390	490.000
150	60,800	14.10	16.80	16.86	1,393	508,000

in fact locomotive tests have demonstrated beyond doubt the absolute interdependence of every element in the operation of the locomotive. For instance, every variation in the quantity of steam used requires a corresponding variation in the unit quantity of coal fired; the coal consumption is dependent upon the degree of smokebox vacuum, which varies with the pressure in the exhaust nozzle and passages. It is therefore evident that any decrease in the weight of steam passing through the nozzle, unless accompanied by a proportionate decrease in the amount of fuel consumed, will be detrimental.

Extensive tests made on the locomotive in question have proven this statement. In Table I will be found the amount of steam fed to the cylinders (Column 2),—the effective draft, or the difference between the draft ahead of the diaphragm and that in the firebox—(Column 3), the pressure in the exhaust passages (Column 4), for varying rates of fuel consumption (Column 1). Thus it will be seen that at a fuel rate of 120 lb. per sq. ft. of grate surface per hour, the

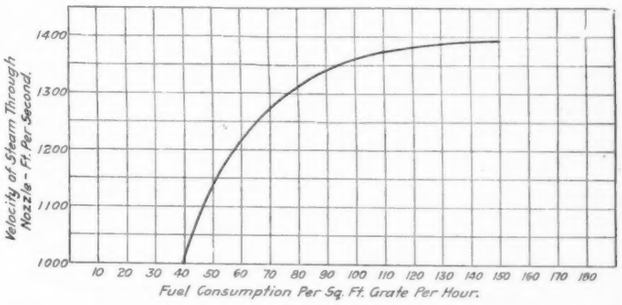

Velocity of Steam Through Nozzle - Ft. Per Second.
1400
1300
1200
1100
1000
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Fuel Consumption Per Sq. Ft. Grate Per Hour.

Fig. 1—Velocity of Steam Through the Nozzle for Different Rates of Fuel Consumption

effective draft is 11.8 in. of water, the amount of steam passing through the cylinders is 54,400 lb. per hour, and exhaust passage pressure is 13.7 lb.

It will be understood that the definite proportions as given in this table apply only to an engine having the characteristics shown above, however the principle involved applies to all locomotives.

Having this data, it is possible to determine the area of nozzle required to produce the necessary draft, when diverting a predetermined proportion of the exhaust steam.

$$M = \frac{F\,W}{V} \qquad (1)$$

Where:

M = Weight in pounds of fluid flowing past a given section per second.
F = Area of given section in sq. ft.
W = Mean velocity in feet per second of the fluid at the given section.
V = Volume per unit weight (cu. ft. per lb.) of steam in exhaust nozzle.

TAKING THE PROPORTIONS FROM TABLE I:

$$M = \frac{54{,}400}{3{,}600} = 15.1 \text{ lb.}$$

$$F = \frac{38.19}{144} = .265 \text{ sq. ft.}$$

$$W = \frac{M\,V}{F} = 1{,}381$$

$V = (13.7 + 14.7) \times 0.58 = 16.46$ lb. corresponding to 24.16 cu. ft.

The pressure at the throat or the smallest area of the nozzle equals 58 per cent of the initial pressure, when the ratio of the final pressure to the initial pressure is less than that quantity.

Let E equal the kinetic energy of the steam escaping

through the nozzle, which is the force producing draft, then:

$$E = 0.5 \frac{M}{32.2} W^2 \quad \ldots\ldots (2)$$

$$E = 0.5 \frac{15.1}{32.2} 1{,}381^2 = 448{,}000 \text{ foot pounds.}$$

This is the force required per second to create an effective vacuum of 11.8 in. of water, when burning fuel at the rate of 120 lb. per sq. ft. of grate per hour.

It will now be assumed that 15 per cent of the steam passing through the cylinders is diverted for heating the feed water, this steam being taken from a point between the valve and the nozzle, at a pressure of 13.7 lb. per sq. in.; having this data it is possible to determine the area of nozzle needed to produce the required draft with the diminished weight of steam.

Table I, columns 6 and 7 give the quantities W and E for rates of combustion of 40 to 150 lb. dry coal per hour, when producing the weight of steam shown in column 2 and with the total quantity of steam produced passing through the nozzle. It is evident that if the same rate of evaporation and fuel consumption are to be maintained, with only 85 per cent of the steam passing through the nozzle; in order to

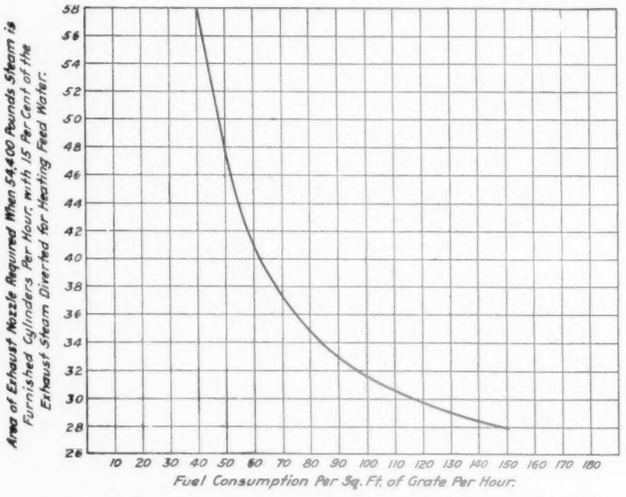


Fig. 2—Area of Nozzle in Square Inches for Various Rates of Combustion

maintain the same kinetic energy, the speed of the steam through the nozzle, or W must be increased.

Let $M_1 = \dfrac{54{,}400 \times .85}{3{,}600}$; W_1 equal the required velocity of the steam, and F_1 equal the area of nozzle required to produce the necessary draft, then will

$$W_1 = \sqrt{\frac{E}{.5 \times \frac{M_1}{32.2}}} \quad \ldots\ldots (3)$$

$$F_1 = \frac{M_1 V_1 144}{W_1} \quad \ldots\ldots (4)$$

The values of W_1 *and* F_1, are shown by curves in Figs. 1 and 2 plotted over the unit fuel consumption. It will be seen from these diagrams that the area of the exhaust nozzle depends directly upon the economy given by the feed water heater, and that for this locomotive to require the original area of nozzle, the economy must be such as to reduce the unit fuel consumption to approximately 68 lb. per sq. ft.

Fig. 3 illustrates diagrammatically the type of exhaust steam heater in which the feed water circulates through the annular passages between the inner and outer tubes, the heating medium flowing through the inner tube and surrounding the external surface of the outer tube. To provide sufficient volume the pipes are arranged in pairs, six such pairs or units forming the heater. The feed water is forced by a feed pump into the header at one end of the heater, it then flows in annular columns to the opposite header, traversing the entire length of the heater and flowing thence to the boiler. The heating medium (exhaust steam) is taken from any convenient point between the cylinder and the

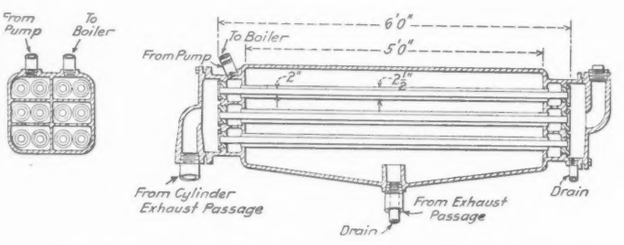


Fig. 3—A Type of Exhaust Steam Feed Water Heater

exhaust nozzle. It enters the heater at one end flowing through the twelve internal pipes to the opposite header, exhaust steam also enters the casing and surrounds the outer pipes, the condensate being carried to any convenient point.

For a heater of the dimensions shown in Fig. 3 the total traverse of the feed water is 30 ft. and of the exhaust steam in the inner channels, is approximately 6 ft.; the total heating surface in tubes is 71.22 sq. ft. As a modern boiler feed pump will deliver 100 lb. of water against a boiler pressure of 205 lb. for 1.75 lb. of steam, the total weight of water per hour passing through the heater is 54,400 × 1.0175 = 55,390 lb. or 15.35 lb. per second.

The volume per foot of the annular space between a pair

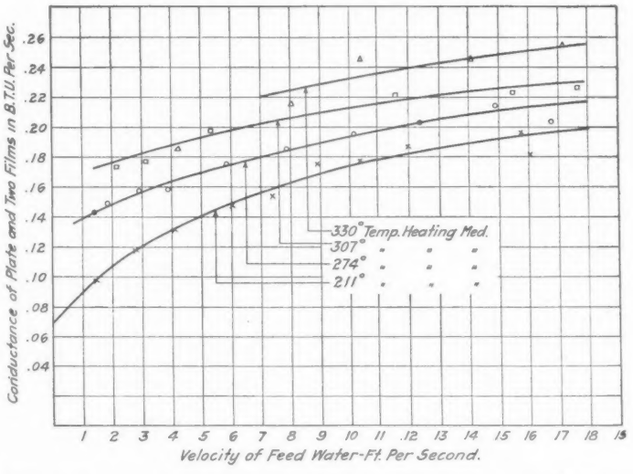


Fig. 4—Conductance Values at Different Temperatures at Various Feed Water Velocities

of tubes in the heater Fig. 3 is 26.96 cu. in. and the weight of water at 60 deg. is .972 lb. per foot of tubes. The velocity of water passing into the heater is $\dfrac{15.35}{.972} = 15.75$ ft. per second.

The pressure of the exhaust steam entering the heater is 13.7 lb. gage or 28.4 lb. (absolute) the corresponding temperature of saturated steam being 247 deg. F.

As the outlet or condensate pipe from the heater exhausts into the atmosphere, the heater is at all times under atmo-

spheric pressure, consequently while steam is present the mixture cannot fall below 212 deg. The temperature range of the heating medium is 247 deg.-212 deg. = 35 deg., and the average temperature through the heater is .5(247-212) = 230 deg.

To determine the amount of heat transmitted to the feed water in its passage through the heater it is necessary to consider the rate at which the heat flows through the tube

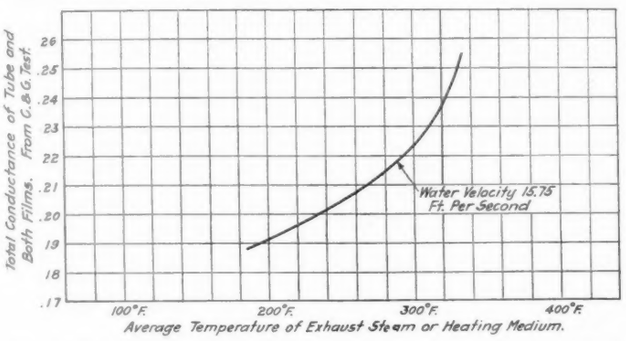


Fig. 5—Total Conductance for Various Average Temperatures at a Feed Water Velocity of 15.75 Ft. Per Sec.

walls. The experiment of Clement and Garland (Bulletin No. 40, Engineering Experiment Station, University of Illinois) affords valuable data on the transmission of heat from steam to water. In the flow of heat from a medium, gaseous or liquid, in contact with a metal plate, to a medium in contact with the opposite side of the plate there are three resistances to be overcome. These are the resistance of the film between the heating medium and the plate on one side, the resistance due to the metal of the plate, and the film between the plate and the liquid receiving heat.

From the data obtained by Clement and Garland, diagram Fig. 4 has been prepared, giving the relation between the velocity of the feed water in feet per second, and the total conductance of the plate and the two films in B.t.u. per second, for the various temperatures of the heating medium obtaining in the test.

In diagram Fig. 5, a relation is established between the temperature of the heating medium and the total conductance. As the range and conditions of this test are fairly comparable with those which we have assumed for the present study, no great error can arise in accepting them.

We have found that the velocity of the feed water through the heater Fig. 3 is 15.75 ft. per second. Taking the intersections for this velocity from Fig. 4 and establishing the corresponding curve on Fig. 5, we find that for a velocity of 15.75 ft. per second the total conductance is .1985 B.t.u. per second per sq. ft. of heating surface, for each degree of temperature difference. As each lineal foot of the heater units contains 2.374 sq. ft. of heating surface; the total conductance per lineal foot equals 2.374 × .1985 = .4712 B.t.u. per degree of temperature difference between the heating medium and the feed water.

Th heat transmitted by any given section of the heater may be determined by the equation:

$$Q = k^{\circ} A\, hm \qquad (5)$$

In which:

Q = Heat transmitted in B.t.u. per second.
k° = Coefficient of heat transfer, or conductance.
A = Area in sq. ft. through which the transfer is in progress.
hm = Mean temperature difference for the process.

Assuming that the feed water enters the heater at a temperature of 60 deg., corresponding to a thermal content of 28.08 B. t. u. and with the average temperature of the heating medium 230 deg., the heat absorbed per pound of water through the first lineal foot is given by the equation.

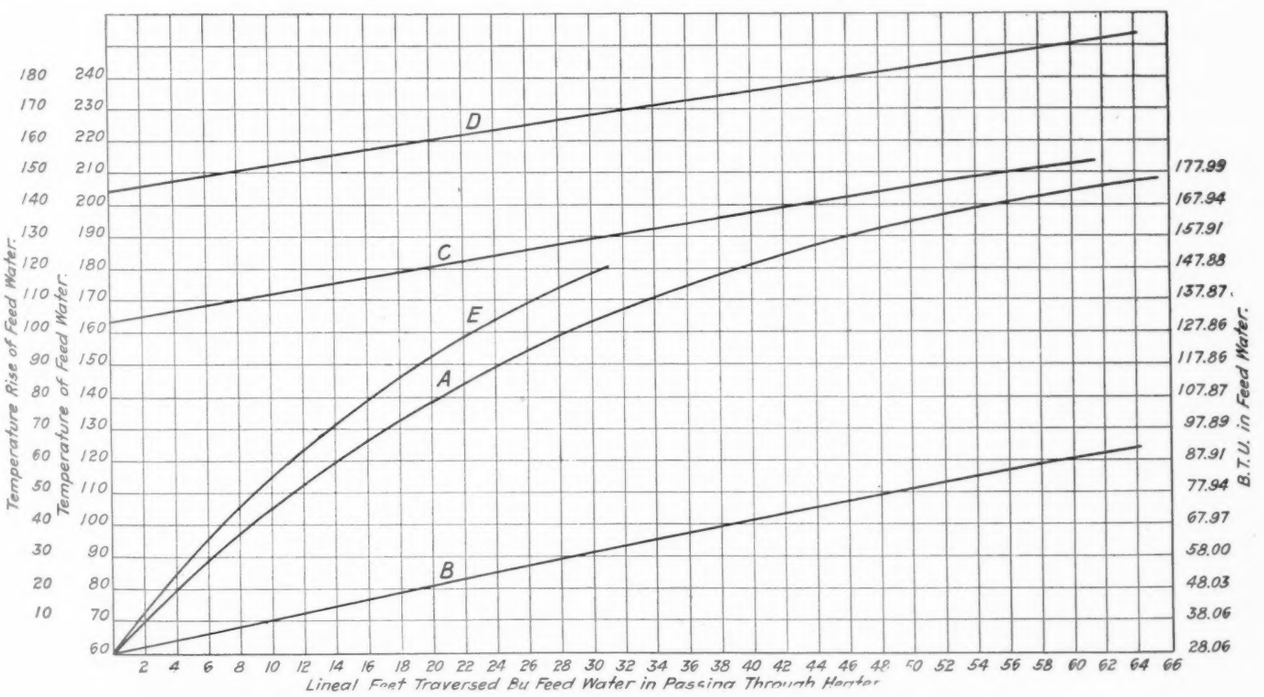


Fig. 6—Rise in Feed Water Temperature Per Lineal Foot of Feed Water Heater Pipes

$$Q = \frac{k^{\circ} A\, hm}{s\, w} \qquad (6)$$

In which:

s = Velocity of feed water in feet per second.
w = Weight of water in one lineal foot of heater.

using the quantities found above:

$$Q = \frac{.1985 \times 2.374 \times (230 - 62.5)}{15.75 \times .972} = 5.16 \text{ B. t. u.}$$

Thus at the end of the first lineal foot the heat content of the feed water is 28.08 + 5.16 = 33.24 B. t. u., corresponding to a temperature of 65.2 deg.

By a similar step by step process we find that at the end of 30 lineal feet, the heat content of the water has increased to 131.1 B.t.u. corresponding to a temperature of 163.3 deg., or a rise in temperature above feed water of 103.3 deg.

Fig. 6 curve *A* represents this rise in temperature and

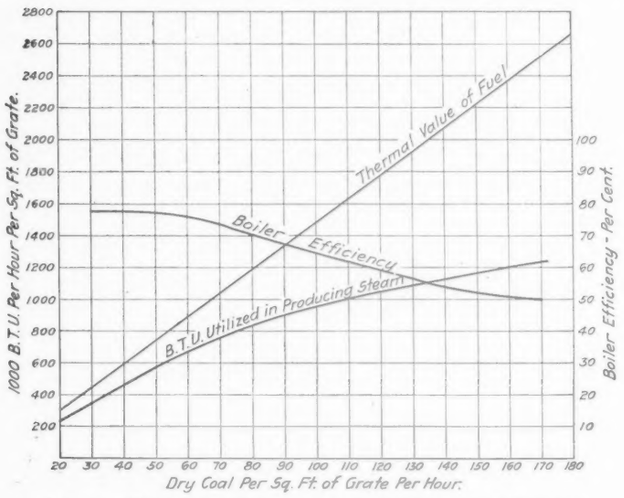

1000 B.T.U. Per Hour Per Sq. Ft. of Grate.
Boiler Efficiency - Per Cent.
Thermal Value of Fuel
Boiler Efficiency
B.T.U. Utilized in Producing Steam
Dry Coal Per Sq. Ft. of Grate Per Hour.

Fig. 7—Efficiency Curves of a Locomotive Boiler Without a Feed Water Heater

heat content, plotted in relation to the lineal feet in the heater, and illustrates the fact that as the temperature difference diminishes, the heat transfer between the steam and the feed water becomes proportionately less. If the heater contained 60 lineal feet, the heat content would be 172.27 B. t. u. and the corresponding temperature 204.03 deg., or a rise in temperature above feed water of 144.3 deg., an

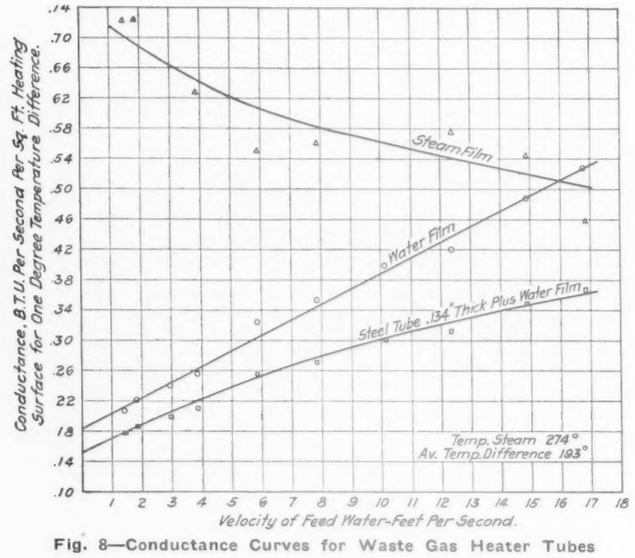

Conductance, B.T.U. Per Second Per Sq. Ft. Heating Surface for One Degree Temperature Difference.
Steam Film
Water Film
Steel Tube .134" Thick Plus Water Film
Temp. Steam 274°
Av. Temp. Difference 193°
Velocity of Feed Water-Feet Per Second.

Fig. 8—Conductance Curves for Waste Gas Heater Tubes

increase of only 41 deg. in the last 30 ft. as against 103.3 during the first 30 ft.

For a heater having a traverse of 30 lineal feet, the heating medium in its passage through the heater has given up 103.08 B. t. u. by its temperature drop from 247 deg. to 212 deg. As the weight of steam passing through the heater per second is 2.265 lb. and the thermal value of one pound at 247 deg. is 1,162.8 B. t. u., the total heat available per second is 2.265 × (1162.8—180) = 2,227 B. t. u. The heat absorbed by the feed water per second is:

$$\frac{.972 \times 30 \times 103.8 \times 15.75}{30} = 1,582 \text{ B. t. u.}$$

The heat remaining in the condensate is 2,227 — 1,582 = 645 B. t. u., or 285 B. t. u. per lb. In other words, the dry steam will condense in the heater until the mixture contains 285 B. t. u. per lb. above the heat of the liquid, and will be discharged with this heat content, at a temperature of 212 deg. and at atmospheric pressure.

The total thermal content of the exhaust steam passing through the heater per pound of feed water is:

$$x = \frac{2,227 \times 30}{.972 \times 30 \times 15.75} + 28.08 = 173.58 \text{ B. t. u.}$$

This corresponds with a temperature of 205.6 deg. Reading from curve *A* on Fig. 6 it will be seen that this quantity of heat is absorbed by a heater of 61.6 lineal feet.

The direct economy is given by the following equation:

$$100 - \frac{H_1 - (H_2 - H_3)}{H_1} = \text{percentage of economy} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

In which:

H_1 = B. t. u. in steam at boiler pressure less B. t. u. in feed water.
H_2 = B. t. u. absorbed by feed water in passing through heater.
H_3 = B. t. u. per lb. of steam required for operating feed pump.

Applying this equation to a heater having a traverse of 30 lineal feet, we have a direct economy of:

$$100 - \frac{1,170.42 - (103.8 - 30.48)}{1,170.42} = 7.2 \text{ per cent.}$$

In addition to the direct economy,—or the reduction in the number of thermal units which the boiler must supply,—there is an indirect saving due to the diminished boiler losses resulting from the decreased fuel consumption. Fig. 7 gives the relation between the thermal value of the fuel fired and that utilized in the production of steam, in other words the boiler efficiency as determined from the tests of the locomotive. This boiler efficiency is plotted in relation to the unit fuel consumption per hour.

It has been shown that the locomotive not equipped with a heater consumes 120 lb. of dry coal per hour, per sq. ft. of grate surface when evaporating 54,400 lb. of water. With a heater of 30 lineal feet, the unit fuel consumption is:

$$\frac{120 \times 1.087.82}{1,170.42} = 111.5 \text{ lb.}$$

For the heater having 60 lineal feet, it is:

$$\frac{120 \times 1,046.71}{1,170.42} = 107.5 \text{ lb.}$$

Referring to Fig. 7, for a unit fuel consumption of 120 lb., the boiler efficiency is 59 per cent, and for a unit consumption of 111.5 lb., an efficiency of 61.6 per cent, an indirect economy of 61.6 — 59 = 2.6 per cent, which added to the direct saving as found above, gives a total economy of 7.2 + 2.6 = 9.8 per cent.

Similarly we find that with a unit consumption of 107.5 lb., the boiler efficiency is 62.5 per cent, and the indirect economy equals 3.5 per cent, with a total economy of 14.2 per cent for the heater having a traverse of 60 lineal feet.

This is the maximum economy obtainable with the heater in Fig. 3 when diverting 15 per cent of the exhaust steam.

In a paper read by George M. Basford, as reported in the Journal of the American Society of Mechanical Engineers, for September, 1917, a design of feed water heater is illustrated, in which the feed water passes in a thin film between two spirally corrugated copper tubes. The statement is made that heat transfers greater than 900 B. t. u. per sq. ft. per hour per degree of temperature difference have been obtained with this device.

The value *K* or the conductivity of the steel tube as ex-

perimented with by Clement and Garland is 48.36 B. t. u. The value of K for copper as given in Marks' handbook is 220 B. t. u. Using the same thickness for the copper tube as for the steel tube experimented with, the conductance of the former is:

$$\frac{220 \times 1.204}{48.36} = 5.48 \text{ B.t.u.}$$

The conductance of the steel tube is 1.204 B. t. u. We can combine this conductance with that of the two films as established by Clement and Garland, by taking the value shown in Fig. 8 for a water velocity of 15.75 ft. per second.

It will be observed that the curve for the conductance of the water film is approximately a straight line; while the curve for the combined conductance of tube and film drops away as the velocity of the water through the tube is increased; indicating that the conductance of the metal in the tube is not constant for all velocities.

Reading the values from the diagram, we have:

$$\frac{1}{\frac{1}{.354} - \frac{1}{.505}} = 1.184 \text{ B.t.u.}$$

This gives the conductance of the metal in the tube at the given velocity of the feed water. Assuming that the conductance of the copper tube will decrease with the velocity in the same ratio, we have as the conductance:

$$\frac{1.184 \times 220}{48.36} = 5.39 \text{ B.t.u.}$$

Combining this conductance with that of the film, we have:

$$\frac{1}{\frac{1}{.505} + \frac{1}{5.39} + \frac{1}{.512}} = .243 \text{ B.t.u.}$$

The conductance in B. t. u. per sq. ft. of heating surface is then, $.243 \times 3600 = 875$, this agrees very closely with the figure given by Mr. Basford, or 900 B. t. u.

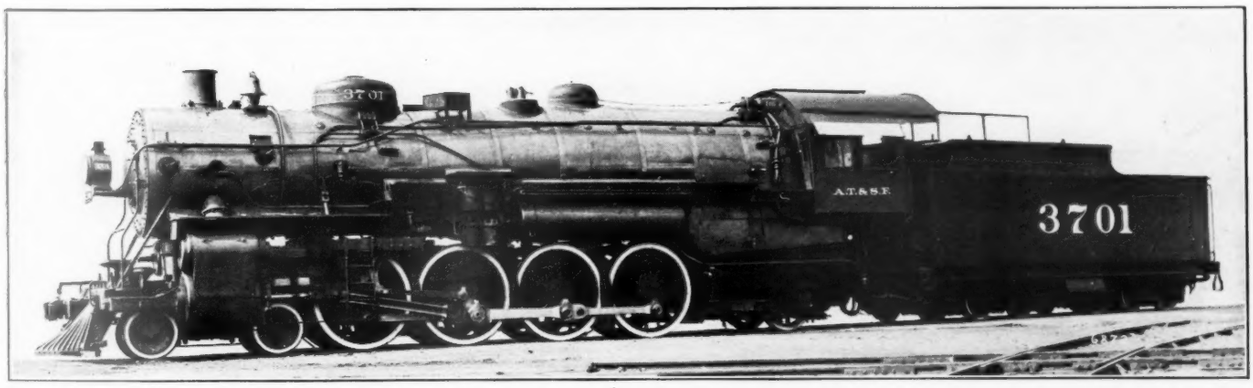
Using the latter figure, we have $\frac{900}{3{,}600} = .25$ B. t. u. conductance; substituting this value in equation (6), we have for the heater Fig. 3 with 30 lineal feet traverse, a final temperature of 178.05 deg. with a thermal content of 145.93 B. t. u. This increase in temperature is illustrated by curve E in Fig. 6. From the figures given it would seem that the increased efficiency of the heater shown by Mr. Basford is due chiefly to the higher conductance of the metal used.

(*To be Continued.*)

A. T. & S. F. 4-8-2 TYPE LOCOMOTIVES

Heaviest of the Type Yet Built; Two of Similar Design, Differing in Detail and in Fuel Used

IN JUNE, 1918, the Atchison, Topeka & Santa Fe received from the Baldwin Locomotive Works, two Mountain type locomotives for use in passenger service, which are designed to develop 54,100 lb. tractive effort. These engines bear the road numbers 3700 and 3701, and although they are generally similar in design there are a number of differences in the details. Engine 3700 is fitted for coal burning service and has the Baker valve gear, while engine 3701 burns oil and is equipped with the Walschaert valve gear.



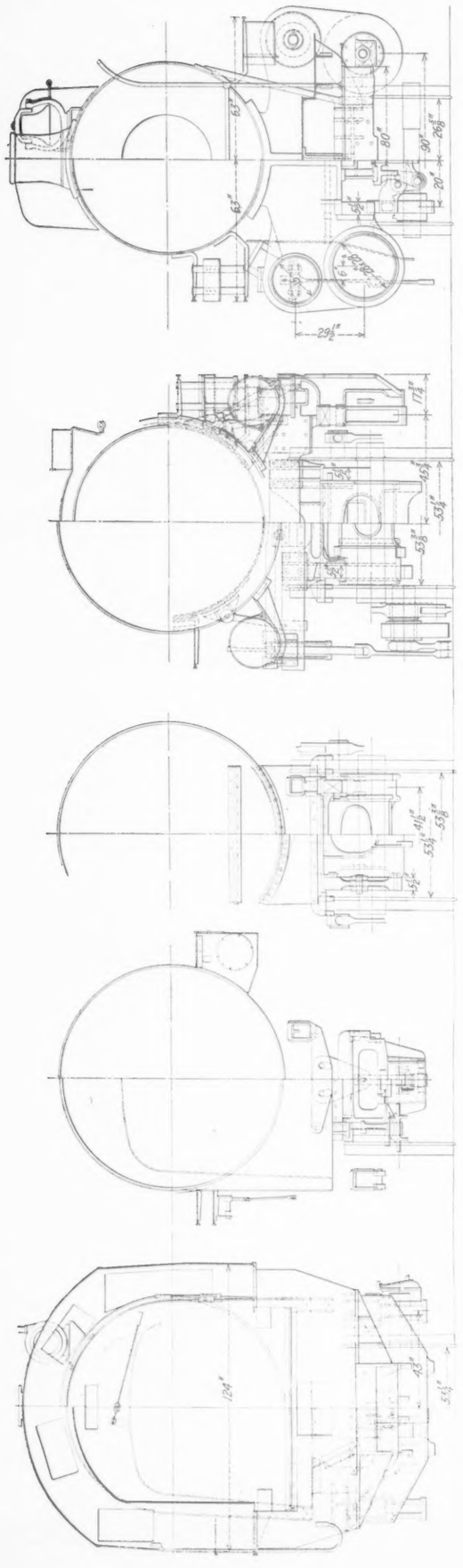
One of the Two Mountain Type Locomotives Recently Built for the Atchison, Topeka & Santa Fe

There are other differences which will be referred to later.

The proportions of these locomotives as a whole compare favorably with any of the same type which have been built heretofore. They are the heaviest of the type thus far built and with one exception have not been exceeded in tractive effort by any 4-8-2 type locomotives having driving wheels of equal or greater diameter. The locomotives built by the Norfolk & Western in 1916, with drivers and cylinders each one inch larger in diameter than the Santa Fe engines, develop a tractive effort of 57,200 lb. A comparison of the dimensions of the Santa Fe locomotives with those of other notable 4-8-2 type locomotives is presented in the table.

Using Cole's ratios as a basis of comparison, the Santa Fe locomotives have ample evaporative capacity, the boiler being something over 100 per cent in this respect. The grate, however, is relatively small, and has a rating of only 87 per cent. In other words, the development of the maximum horsepower which should be obtained from cylinders of the size employed on these engines, at the rate of 3.5 lb. of coal per horsepower-hour, will require an hourly combustion rate of 138 lb. per sq. ft. of grate instead of the 120-lb. rate on which Cole's ratios are based. The New York Central locomotives referred to in the table have a 98 per cent boiler, with a slightly higher grate rating, and the Norfolk & Western locomotives have a boiler between 80 and 90 per cent, with a 90 per cent grate.

Apart from the changes incident to the use of different



Elevation and Sections of the Santa Fe 4-8-2 Type Locomotives

fuels, the boilers of the two Santa Fe locomotives are alike. A conical ring is placed in the middle of the barrel, increasing the shell diameter from 82 in. at the front end to 96 in. at the throat. The firebox has a combustion chamber 45½ in. long, and arch tubes are used in both the boilers. An arch is fitted in the coal-burning locomotive, which is fired with a Duplex mechanical stoker and is equipped with power-operated grate shaker and fire door. On engine 3701 the standard arrangement of Santa Fe oil-burning equipment, with Booth burner, is used. The superheaters are of the same size as those used in the Santa Fe 3160 class Mikado type locomotives.

Flexible staybolts are applied in the breaking zones in the sides, back and throat of the firebox, and in the sides and bottom of the combustion chamber, while four rows of expansion stays support the forward end of the combustion chamber crown. In the case of such of the expansion-stays as cannot be placed radially with relation to the outside shell, bosses are electrically welded to the roof sheet in order to provide a sufficient number of threads for the staybolt sleeves.

COMPARISON OF PRINCIPAL DIMENSIONS OF NOTABLE 4-8-2 TYPE LOCOMOTIVES

Road	Santa Fe	N. Y. C.	N. & W.	C.R.I.&P.
Year built	1918	1916	1916	1913
Tractive effort, lb.	54,100	50,000	57,200	50,000
Total weight, lb.	353,900	343,000	341,000	333,000
Weight on drivers, lb.	227,700	234,000	236,000	224,000
Cylinders, in.	28 by 28	28 by 28	29 by 28	28 by 28
Boiler pressure, lb. per sq. in.	200	185	200	185
Diameter of drivers, in.	69	69	70	69
Evaporating heating surface, sq. ft.	4,790	4,430	3,984	4,117
Superheating surface, sq. ft.	1,086	1,212	882	994
Grate area, sq. ft.	71.5	66.8	80.3	62.7

The main dome is located immediately in front of the combustion chamber, while the auxiliary dome is farther forward on the conical ring. This dome is placed on the left-hand side of the boiler over a 17-in. opening, the center of which is 14 in. from the longitudinal boiler center. The opening thus clears the dry pipe, and permits easy entrance to the boiler for inspection purposes.

The dynamic augment in rail pressure due to the effect of the counterbalance, is kept within reasonable limits by using comparatively light reciprocating and revolving parts made of special materials. The piston heads are steel castings of dished section, while the piston rods, main rods, side rods and main crank pins are of Nikrome steel. The piston rods are of the extended type. The crossheads interchange with those of the 3160 class Mikados and are of the Laird type, with comparatively light bodies of .40 per cent carbon steel. Fifty per cent of the weight of the reciprocating parts is balanced. The driving-wheels are fitted with Mansell tire retaining rings.

Locomotive No. 3700, with the Baker valve motion, is equipped with piston valves of the Santa Fe standard design and with the Ragonnet type *B* power reverse mechanism; while locomotive No. 3701, which has the valves operated by the Walschaert motion, is equipped with the American Balanced Valve Company's piston valves and the Lewis power reverse gear.

The running gear details include several features of interest. The main frames have a width of 5½ in. and the upper and lower frame rails between adjacent pairs of driving pedestals are united by vertical ribs, which are cast in one piece with the frame and greatly increase its strength in a vertical direction. These ribs support the equalizing beam fulcrum pins. The frames are braced transversely at each pair of driving pedestals and also midway between the pedestals. Long journals with driving boxes of the Cole type are used on the main driving axle and the shoes and wedges interchange with those of the 3160 class Mikados. The rear frame is of the Commonwealth cradle pattern, and in this case is used in combination with the Delta trailing truck. Locomotive No. 3700 is equipped with a leading truck of the Economy constant resistance type, while the leading truck of No. 3701 has three-point suspension swing links and a one-piece, cast steel frame in lieu of a frame of the built-up design generally used.

The guide-yoke and valve motion bearer of each locomotive are braced to the boiler by heavy wrought iron rods having jaws on their upper ends which are pinned to brackets studded to the boiler shell. These brackets are fitted against external liners riveted to the boiler shell. Ample strength is thus provided in a vertical direction, while provision is made for lateral movement due to the expansion and contraction of the boiler shell.

The tenders have six-wheel trucks and one-piece, cast-steel frames and the details interchange with those of the Mikado type locomotives previously mentioned.

Although these locomotives represent a type that is new to the Santa Fe system, and are in a certain sense experimental, their design is based on that of locomotives which are giving satisfactory results on this road, and no radically new features are embodied in their construction. Few railways in this country present more difficult operating conditions than the mountain divisions of the Santa Fe, where there is an excellent field for demonstrating the capacity and efficiency of the Mountain type locomotives in general, in heavy passenger service.

The table which follows presents the principal dimensions and data pertaining to these locomotives:

General Data

Gage	4 ft. 8½ in.
Service	Passenger
Fuel	Oil, soft coal
Tractive effort	54,100 lb.
Weight in working order	353,900 lb.
Weight on drivers	227,700 lb.
Weight on leading truck	65,700 lb.
Weight on trailing truck	60,500 lb.
Weight of engine and tender in working order	587,600 lb.
Wheel base, driving	18 ft.
Wheel base, total	39 ft. 5 in.
Wheel base, engine and tender	76 ft. 8⅛ in.

Ratios

Weight on drivers ÷ tractive effort	4.2
Total weight ÷ tractive effort	6.5
Tractive effort × diam. drivers ÷ equivalent heating surface*	581.5
Equivalent heating surface* ÷ grate area	89.8
Firebox heating surface ÷ equivalent heating surface,* per cent.	5.8
Weight on drivers ÷ equivalent heating surface*	35.5
Total weight ÷ equivalent heating surface*	55.1
Volume both cylinders	19.9 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	322.6
Grate area ÷ vol. cylinders	3.6

Cylinders

Kind	Simple
Diameter and stroke	28 in. by 28 in.

Valves

Kind	Piston
Diameter	15 in.

Wheels

Driving, diameter over tires	69 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	12 in. by 20 in.
Driving journals, others, diameter and length	11 in. by 12 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	7 in. by 12 in.
Trailing truck wheels, diameter	47 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Conical wagon-top
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	82 in.
Firebox, length and width	122¼ in. by 84¼ in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ½ in.
Firebox, water space	Front and sides, 5 in.; back, 4½ in.
Tubes, number and outside diameter	253—2¼ in.
Flues, number and outside diameter	43—5½ in.
Tubes and flues, length	21 ft.
Heating surface, tubes and flues	4,416 sq. ft.
Heating surface, firebox, including arch tubes	374 sq. ft.
Heating surface, total	4,790 sq. ft.
Superheater heating surface	1,086 sq. ft.
Equivalent heating surface*	6,419 sq. ft.
Grate area	71.5 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	233,700 lb.
Wheels, diameter	33 in.
Journals, diameter and length	5½ in. by 10 in.
Water capacity	12,000 gal.
Oil capacity	4,000 gal.

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

SUPERHEATER LOCOMOTIVE PERFORMANCE*

Superheating as adapted to locomotive service established itself as practical, simple and economical several years ago. So much evidence has been presented from time to time, showing the benefits derived from superheating, that the case is well proven, and further substantiation here is out of place. Our problem is one of maintenance and operation, one of getting full measure of return out of the 25,000 superheater locomotives in service in the United States. They are capable of returning or saving 20 per cent to 25 per cent in coal per unit of work done; they are capable of doing 25 per cent to 30 per cent more work per locomotive than similar saturated steam locomotives, either by hauling heavier trains at given schedules, or given trains at faster schedules. These are positive and direct returns that have been established under day by day operating conditions and are to be expected at all times.

Now, more than any time in the past, is it imperative that locomotives should be kept in a condition to sustain 100 per cent operating load. Every hour of high priced labor must be made to produce the most, and not wasted in working out some uncertain guess. In the same way every pound of expensive material must be made to earn its high cost; that is, locomotives should leave the freight yard fully loaded to a rating of higher authority than that provided by the ability of a poor fireman. The emergency of the times demands that full measure be returned from every unit employed. Incompetence and carelessness have no place in the present emergency. Locomotives must be operated and maintained by those who *know* and who *will*. The full measure of the superheater locomotive is 100 per cent of its rating at all times on a minimum consumption of coal and water.

To illustrate more clearly what is meant, the committee takes the liberty of abstracting a recent paper by C. M. Darden, read before the Southern & Southwestern Railway Club. Tests of a Mikado type locomotive developed that a change of ⅜ in. in the diameter of the exhaust tip increased the firebox temperature about 400 deg. by increasing the draft, thereby providing more complete combustion, with a resultant saving of $57,000 in coal per year. The locomotive seemed to be performing satisfactorily before the change, with no complaint from the crew. Adjustment in the valve gear showed an increase of 7.8 per cent in drawbar horsepower; thus permitting this locomotive to haul the same tonnage at a higher sustained rate of speed or a proportionate increase in tonnage rating at the same rate of speed. There are several engines of this type in the same class, which multiplies the benefit to the railroad.

Similar investigation of a Ten-wheel locomotive which had been converted by the application of a superheater, indicated changes which, when carried out, improved the coal economy 9.8 per cent and also resulted in making up 34 min. on a schedule previously involving delays of over 50 min. The engine is now hauling three additional cars and burning less coal.

Parts of superheater locomotives which may affect economy should be very carefully watched for proper size and adjustment. Air openings in ash-pans on many locomotives are insufficient. Grate designs are not adaptable to the kind of fuel burned. Exhaust nozzle size and location bear a direct relation to fuel economy. Front end arrangement and adjustment, with special attention to the prevention of steam or air leaks, furnish opportunity for improvement in many cases. Stack design, size and location, can be given closer attention with profitable results. Many other items might be enumerated constituting things that it is more convenient to get along with than to correct, as the engine probably runs satisfactorily to those who do not have the owners' interests particularly at heart. Attention to them, however, would increase the earning power of the machine for the operators and move more freight.

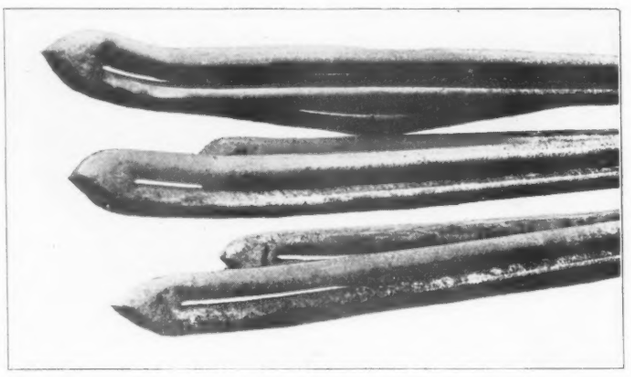
Just as any machine requires care and attention to keep its production at a maximum, there are certain fundamentals in maintenance and operation which are essential to the 100 per cent performance of the superheater locomotive. They are easy to comprehend and simple to carry out, but to insure 100 per cent performance they must be kept constantly in mind and continuously carried out by both shop and enginemen.

IMPORTANCE OF CORRECT MAINTENANCE

Correct maintenance in the back shop and the engine house is essential to the best operating results on the road. Unless a locomotive is turned out in first-class condition, first-class performance, from an operating standpoint, cannot reasonably be expected from it. The superheater requires a minimum of attention to keep it in good condition. If it is not given this attention, the superheater *may* be injured; but the performance of the locomotive certainly *will* be injured.

CLEAN FLUES

Examine a piece of metal that has been lying in a bed of cinders and note the corrosion that has taken place. Imagine that there is added to this corrosion the effects of the high temperature reached by cinders, soot and clinkers, which are lying in a boiler flue, and you will have an idea of the



Distorted Ends of Superheater Units, One Result of Stopped-Up Flues

conditions imposed upon superheater units when the flues are not kept clean. A continuation of these conditions is likely to result in burned and warped unit pipes, and burned-off unit bands and supports, permitting the unit to vibrate in the flue. Sooner or later this will necessitate repairs to the superheater, which will require the locomotive to be held out of service. This might be called the indirect result of not keeping the flues clean; the direct result is the shutting off of part of the hot gases from reaching the superheater units and also the evaporative surface of the flue; the amount of superheat in the steam falls off and the effective performance of the locomotive is reduced. If the flue becomes

*Abstract of committee report presented at the 1918 convention of the Traveling Engineers' Association.

completely stopped up, the effect is aggravated. One large flue of a 25-unit locomotive superheater stopped up in this way, reduces the capacity of the superheater 4 per cent and the total superheating capacity falls off 4 per cent more for every additional plugged flue.

There should be no need of a remedy for this condition; what is required is a preventative. Thorough, systematic, regular cleaning of all flues, large and small, obviates the difficulties resulting from plugged flues. Spasmodic, half-hearted poking with a rod at one or two flues which appear to be the worst is not flue cleaning. Correct flue cleaning must be a matter of shop routine. Don't wait to clean the flues until there is a steam failure and a delayed train. Keep them clean all the time and prevent the failure. It is not only the cheapest in the long run, but it is the easiest. To knock a little clinker off one or two units, and blow a small accumulation of soot and cinders through into the front end with a 3/8-in. pipe on the end of an air hose is a small job. However, with 15 or 18 large flues and 40 or 50 small ones plugged solid with cinders for several feet and the cinders embedded around the superheater units so that a bar has to be used to loosen them, the job of flue cleaning assumes considerable proportions. It is prevention that is needed; not cure.

MAINTAINING SUPERHEATER UNITS

There are two main considerations bearing on the maintenance of tight joints between the superheater units and the header; correct grinding of the unit ball ends and their seats in the header; and the quality of the material and manufacture in the unit clamp bolts. It must be borne in mind that while the unit end is spherical, with a radius of 1 1/16 in., the header seat is not spherical, but conical, with an angle of 45 deg. The ball end, when correctly ground, has a line bearing of 1/32 in. to 3/32 in. wide in the header seat.

In repairing these joints, it is seldom necessary to remove any metal with a cutting tool, unless the seats are scored or cut, and then only enough metal should be removed to true up the seats. In the great majority of cases, a light grinding with the soft metal grinding process will restore both the header seats and the unit ends to a good bearing. With correct grinding of these seats, the key to tight joints lies in the unit clamp bolts. These should have a tensile strength of not less than 100,000 lb. per sq. in., and an elastic limit of not less than 75,000 lb. per sq. in., and the nuts must be capable of developing the full strength of the bolt. When bolts of ordinary iron, of low tensile strength are employed, the material has not the necessary strength to resist the force applied by a man in setting up the nuts with a wrench, so that the bolt stretches, the ball end does not seat tightly in the header, and a steam leak results.

The bands and supports which hold the unit pipes together and the unit in its place in the flue are important factors in maintaining tight joints at the header. The supports not only hold the pipes together, but support the unit in its correct position in the flue. The correct application of bands and supports is vitally important. If bands are applied where supports should be, the unit will not be supported firmly in position clear of the walls of the flue, but will lie on the bottom and vibrate when the locomotive is in motion. This vibration places a strain on the joint at the header and may result in steam leaks at this point or in damage to the unit pipes.

The effects on locomotive performance of steam leaks in the front end need not be dwelt upon; they are familiar to any one who is familiar with the locomotive and are easily prevented by giving them proper attention in shops and engine houses.

DAMPERS

Consider for a moment what happens in the locomotive with a hot fire in the firebox if the crown-sheet is permitted to become dry. A similar condition exists with the units when the throttle is closed in a superheater locomotive which has no damper. The same condition applies when the throttle is closed and the damper has been fastened in the open position. When the throttle is closed, steam ceases to flow through the superheater units and there is then nothing to absorb any heat which may be delivered to the unit pipes. If the hot gases continued to flow through the large flues, particularly with the locomotive drifting at high speed, the units would become overheated. While damage might not be evident after a single occurrence of this kind, continued overheating will break down the structure of the material and damage the units.

The location of the damper in the smokebox is such that it controls the flow of gases through the large flues, and when the throttle is closed the damper automatically shuts off the flow of gases through these flues and protects the superheater. When the throttle is opened, steam is automatically supplied to the damper cylinder and the damper opens. In switching locomotives, where the boiler is very generally in use when the throttle is closed, it has been found desirable to operate the damper with steam from the blower, and the damper is then normally open except when the blower is in use.

The damper mechanism is very simple and requires but little attention to keep it in good working condition. Given that little attention, it performs its functions and aids materially in securing the best performance from the locomotive. A most pernicious practice is that of fastening the damper in the open position. This practice completely defeats the object of the damper. The damper, properly installed, offers no interference to the draft, and attention to its few maintenance requirements insures its continuing to function correctly. Fastening the damper in the open position to correct a bad steaming condition that is due to neglect of flue cleaning removes the protective feature from the superheater units and does not remove the cause of the trouble. There is nothing to be gained from this practice and the locomotive's performance may be seriously affected because of damage to the superheater units.

Freezing of damper cylinders, sometimes the cause of difficulty in cold weather, is easily prevented by thoroughly lagging both the steam supply and the drain pipes. These pipes should be free from pockets which would permit the collection of moisture.

THE EFFECTS OF HIGH WATER

The economies resulting from the use of superheated steam depend on the temperature to which the steam is superheated. Steam with 250 deg. of superheat will give better results than steam with 150 deg. The superheater will evaporate water; but it cannot do so and at the same time superheat steam. Acting on the assumption that the water level can be carried at the top of the glass in a superheater locomotive, is putting the superheater to work as an auxiliary evaporator or boiler. Water cannot be superheated; it must first be turned into steam, and every square foot of surface that the superheater gives up to the evaporation of water, carried over through the throttle and dry pipe, is lost from the purpose of superheating. Carrying the water at a level which results in priming reduces the superheating capacity of the superheater and injuriously affects the locomotive's performance.

This practice has another bad effect. As a boiler accumulates scale, so does a superheater when it is made to do a boiler's work. The scale formation in the superheater units may become thick enough to insulate the steam pass-

ing through the units so that it cannot absorb the necessary heat from the pipes, and again the locomotive's performance will fall off.

In the operation of superheater locomotives, the water should always be carried as low as the service conditions will permit. It should be impressed on hostlers and others who move locomotives around shops and terminals that flooding the boiler is bad practice. It will result in water going over into the superheater under conditions favorable to the formation of scale; it also encourages leaky units, both of which are followed by a falling off in the performance of the locomotive when it is on the road.

LUBRICATION AND DRIFTING

The successful lubrication of superheater locomotives presents no very difficult problem. Careful study of conditions will generally indicate their cause and suggest means of overcoming it. So-called carbonization of oil in the cylinders is caused by the admission of air when the cylinders are at temperatures above the flash point of the oil and by unconsumed gases being drawn into the valve chambers and cylinders through the exhaust. The practice of drifting with a slightly opened throttle should always be followed. The use of oil having a flash point above the temperature of the steam is also recommended. Experience has demonstrated that the admission of oil to the valve chests only does not provide the necessary lubrication for the cylinders as satisfactorily as when oil is fed directly to them.

A very important consideration in the lubrication of superheater locomotives is the fitting of piston and valve rings. The material used in bushings and rings should be of the best; and the rings should fit the walls and not too tightly. The bore of a cylinder or valve chest, when new, is round, and the rings should be turned round to fit the bore. Turning the rings too large, and then cutting a piece out and springing them into place results in an oval ring in a round cylinder.

Experience has demonstrated that careful fitting of rings of a good grade of material; the use of the throttle, open slightly, when drifting; and the delivery of oil directly to the cylinders as well as to the valve chests will prevent lubrication troubles on superheater locomotives.

THE PROBLEM AND ITS SOLUTION

Clean flues, dampers in good operative condition, units well maintained, water carried at the right level—all of these *must* be. And they *can* be, easily, if every one will do his share. *Prevention* must be borne in mind and acted on by all. There is no other machine of which it is more true than of the locomotive that "an ounce of prevention is worth a pound of cure." *Prevent* plugged flues by cleaning them regularly, when cleaning them is only a little job; *prevent* disabled dampers and damaged units by reporting and having completed the *little* jobs; carry the water at a reasonable level and *prevent* a loss in superheater capacity; drift with the throttle cracked and *prevent* lubrication difficulties. *Prevention* is easy and economical. *Cure* is difficult and expensive; it means overtime, delay and loss of service engine-hours.

The items that have been considered for the most part pertain in particular to the superheater, but the importance of other things must not be overlooked. Correct steam distribution, absence of steam leaks, good maintenance of machinery and proper drafting are all matters of as vital importance to the superheated as to the saturated steam locomotive. But in these, as well as in those features which are more closely related to the superheater, the policy of prevention by overcoming small difficulties when they *are* small, is the simplest and easiest way to produce the results which must be obtained. On the roads which followed this policy, there was a minimum of difficulty experienced last winter. Their example lies before us and all must begin to profit by it now in order to realize the best performance from the superheater locomotive during the winter ahead.

The report was signed by Joseph Keller (Lehigh Valley), chairman, Frederick Kerby (Baltimore & Ohio), Hugh Gallagher (Atchison, Topeka & Santa Fe), J. A. Cooper (Erie), and W. A. Buckbee (Locomotive Superheater Company.)

DISCUSSION

Joseph Keller, chairman of the committee, after reading the report spoke of some tests that were made regarding the lubrication of superheater locomotives which were not completed in time to be included in the report. A vacuum gage was applied to the valve chamber at the point where the relief valve is usually located, to determine the amount of vacuum obtaining under varying conditions. The tests were made on Pacific and Mikado locomotives having a 1-in. and a 1¼-in. steam pipe leading to the cylinders for the purpose of admitting steam while drifting. In a test at 45 m. p. h., with the drifting valve wide open, the vacuum varied from 26 to 36 per cent. With the valve closed it increased to 50 and 66 per cent. In some cases a vacuum of about 80 per cent was obtained with the drifting valve closed. In every case the amount of vacuum was considerably greater with the drifting valve closed than when the steam was being admitted to the cylinders through the drifting valves. This indicated that regardless of the fact that drifting valves are used there is an opportunity for the cylinders to suck in gases from the smoke-box. An analysis of the carbonization found in the valve chamber of the Mikado locomotive showed that 27.72 per cent was oil matter, 23.17 per cent was iron and 59.11 per cent was coke. This shows that the walls are abrazed and iron fillings contribute to the carbonization matter. It also shows that some of the smoke is drawn back through the exhaust nozzle. These tests indicate the necessity of preventing a partial vacuum forming in the cylinders.

F. P. Roesch, fuel supervisor of the Railroad Administration, spoke of some tests made on the El Paso & Southwestern in which it was found that it required a 2-in. steam pipe to keep the cylinder drifting valves closed while the locomotive was drifting, and that the supply of steam for this purpose was very large. He suggested that steam be admitted to the exhaust side of the piston in an endeavor to break the vacuum and at best to dilute the gases drawn into the cylinders. As an example of this he referred to the operation of the old time water brake. He spoke of the necessity of properly maintaining superheaters and of the importance of not carrying the water in the boiler too high. He told of having found superheater units "repaired" by plugging them at the beader with blind gaskets. This is, of course, bad practice and should not be tolerated.

F. Kirby, Baltimore & Ohio, called attention to the fact that a leaky front end door or steam pipe will greatly affect the efficiency of the superheater. He was very much in favor of the use of pyrometers in order that the engine crew may better watch the performance of the locomotive. It also gives an indication of the condition of the locomotive. If the proper degree of superheating is to be obtained, the efficiency of the locomotive will be greatly diminished by keeping the water too high in the boiler. This not only reduces the efficiency of the superheater but injures the superheating joints. The hostler is responsible for a great deal of this trouble. The proper level for the water should be found and marked on the glass. In commenting on cylinder lubrication he has found by tests that unless the valves are in good condition the cylinders will not be properly lubricated. He has found that it is best gradually to close the throttle on superheater locomotives when coming to a stop. The maintenance of the superheater will be greatly

increased if the locomotive is not handled properly. On the Baltimore & Ohio each fuel supervisor is provided with a pyrometer which is applied to locomotives not performing properly as the occasion demands.

Other members spoke of the necessity for proper maintenance of superheater locomotives if the full efficiency of the superheater is to be obtained. One member has found that the cooling of the fire in order to prevent popping reduces the degree of superheat sufficiently to affect materially the efficiency of the locomotive.

RAILROAD ADMINISTRATION NEWS

Director General McAdoo Resigns; Car Orders Held Up; Circulars from Washington and the Regions

WILLIAM GIBBS McADOO has resigned as director general of railroads, effective on January 1, 1919, or upon the appointment of his successor. He announced on November 22 his intention to retire to private life and, after a period of rest, to resume the practice of law in New York City.

Mr. McAdoo's reasons for the step, as given in his letter to the President, were that for almost six years he has worked incessantly under the pressure of great responsibilities, whose exactions have drawn heavily on his strength, and that the inadequate compensation allowed by law to cabinet officers and the very burdensome cost of living in Washington had so depleted his personal resources that he must, for the sake of his family, get back to private life to retrieve his personal fortune. He has received no compensation as director general of railroads and under the law could not be paid a salary for that office in addition to his salary as secretary, of $12,000 a year, although he has fixed the salaries of members of his staff and of his federal managers at figures greatly in excess of his own and is paying his regional directors $40,000 and $50,000 a year.

Mr. McAdoo's announcement of his resignation was totally unexpected and even leading members of his railroad staff appear to have been kept in ignorance of the plan until after it had been given to the press. In spite of the strong reasons officially stated, a flood of speculation was aroused as to the possibility of other motives actuating the step and naturally many political considerations were advanced. The most common suggestion of this character was that Mr. McAdoo intends to become a candidate for President in 1920, and that he is now retiring, at the pinnacle of his success both in his handling of the country's finances and in his management of the railways under war conditions, before subjecting himself to any possibility of loss of prestige under the new conditions.

Naturally there has been much speculation as to whom the President will appoint as director general of railroads, particularly as it is considered that the appointment will give some indication as to whether the new man will be appointed for the purpose of preparing to restore the roads to their owners, or whether he will be expected to continue the process of unification. The names most frequently mentioned are Walker D. Hines, assistant director general, Charles A. Prouty, director of the Division of Public Service and Accounting, and Robert S. Lovett, director, Division of Capital Expenditures. There has been an idea prevalent that Mr. McAdoo would some day relinquish the direction of the railroads to his assistant, but there is also a strong feeling that the President would not appoint a railroad man to the office.

Pending the President's announcement there have been some signs of a cessation of activity on the part of the Railroad Administration as far as new plans for the future are concerned, which have led to some speculation as to whether or not they indicated a plan for an early settlement of the relations of the administration with the corporations. For example, prospective orders for new equipment have been held up and activity in connection with changes in rates has been suspended, although only a week before Mr. McAdoo's announcement of his retirement the newspapers had been allowed to predict an active continuance of the work of completing the railroad unification.

EQUIPMENT ORDERS HELD UP

Some excitement was caused during the latter part of November on account of the request of the Railroad Administration to hold up work on the order for 600 additional standard locomotives which was reported in last month's issue. A few days later, however, instructions were issued to carry the work on these engines on to completion. The prospective orders for 2,000 hopper cars for the Virginian and for the 886 baggage cars for the Railroad Administration, however, have been held up, and it is understood that nothing will be done for the present regarding the expected orders for 375 passenger coaches and 129 combination passenger, baggage, mail and express cars, except that the work of completing the designs for the passenger cars will be taken up at next week's meeting of the Committee on Standard Appliances for Cars and Locomotives. Uncertainty as to what the future may develop as to the continuance of the Railroad Administration, the volume of traffic and the question of prices are also given as reasons.

SENIORITY RIGHTS OF EMPLOYEES IN MILITARY SERVICE

Director General McAdoo has issued general order No. 51 giving the following instructions regarding the seniority rights of employees who have entered the military service:

The majority of railroads under federal control have already made announcement with respect to the preservation of seniority rights for employees who have entered the military service of the Army and Navy, and have indicated that so far as practicable, preference in re-employment or reinstatement would be given to soldiers and sailors when mustered out of the service.

(1) In order that as nearly as practicable there shall be a uniform treatment of this matter, the following general principles will govern:

(a) In the case of an employee having established seniority rights, so far as practicable, and where the employee is physically qualified, he will be restored to such seniority rights.

(b) In the case of employees who do not have seniority rights under existing practices, a consistent effort will be made to provide employment for them when mustered out of military service.

(2) Upon railroads where the assurances given on this subject have been more specific than the provisions of paragraph 1 hereof, such assurances shall be observed.

DIRECTOR GENERAL PROHIBITS CHRISTMAS PRESENTS

Director General McAdoo has issued a circular, No. 64, directed against the practice formerly common, but which has been considerably reduced in recent years, of giving Christmas presents to railroad men. The circular says:

"A practice has grown up by which officers and employees of railroads have been given Christmas and other holiday presents by shippers, and by business houses who furnish supplies and materials to railroads.

"While in many instances these presents do not represent material value, yet the practice is essentially objectionable, and it is the policy of the Railroad Administration that it should be discontinued entirely."

DIRECTOR GENERAL TO SUPERVISE EMPLOYEES' MAGAZINES

Director General McAdoo's office has arranged a plan for exercising a general supervision over the various employees'

magazines published by many of the railroads, without interfering with the present management of each magazine. It has been arranged that they shall have a uniform date of issue and shall be distributed to the employees at the time they receive their pay checks. The director general's office will furnish them with a considerable amount of copy in the shape of orders, circulars and notices regarding the activities of the Railroad Administration and in addition some special articles by members of the organization. A newspaper man, Isaac Gregg, heretofore on the Washington staff of the New York World, has been added to the staff of the director general's office, to assist in preparing publicity matter including the material to be sent to the employees' magazines.

LOCOMOTIVES TO BE STORED AT STRATEGIC POINTS

In order to provide a reserve of power in the congested districts in the eastern section of the country the Railroad Administration has arranged to store 50 of the new standard locomotives at Potomac yards, just outside of Washington, D. C., and 110 in the vicinity of Cleveland, Ohio. It is the aim of the administration to hold these locomotives to clear up any blockades that may occur during the winter.

HENRY BARTLETT TO CONSIDER NEW DEVICES

Henry Bartlett, formerly chief mechanical engineer of the Boston & Maine and a member of the committee on standards for cars and locomotives of the mechanical department of the Railroad Administration, is to devote his attention especially to the examination and testing of new devices for the mechanical department in accordance with rules providing for the submission of new devices and inventions outlined in a circular issued by the division of operation in September.

LUBRICATION OF LOCOMOTIVES

Mechanical Department Circular No. 6 gives the following instructions regarding the lubrication of locomotives:

Investigation has developed that, in many instances, locomotives are not properly lubricated, which in addition to increasing coal consumption also causes excessive wear on cylinders, cylinder packing, valves and valve chambers, as well as on piston rod and valve stem packing.

It has been found that this is due on some roads to the practice of draining lubricators of all oil upon their arrival at the terminal and putting in the exact amount allowed for the trip before leaving. If excessive switching is necessary during the trip, or if any other unusual delays occur, or if the oil feed is not so regulated that it will last during the trip, the locomotive is often operated to the terminal with cylinders not lubricated. Cases are also found where on account of this practice yard engines are worked for hours without cylinder oil. This practice is extremely expensive.

Lubricators should be filled before locomotive leaves terminal, and sufficient oil should be carried on the locomotive to provide against any necessity for damaging cylinders, valves, packing or other parts of the machinery during the trip. Piston rod and valve stem packing should be properly lubricated, and a suitable swab provided to retain the oil.

Enginemen will be held responsible for the proper use of all lubricating oils furnished them.

BAD-ORDER CAR SITUATION

As a continuation of the weekly statement of car condition reports published in the *Railway Mechanical Engineer* of November, page 614, the following three weeks' report is given, together with the percentage of bad order cars by regions, for four weeks ending October 12. It will be noticed that the percentage of bad order cars for all the roads under the jurisdiction of the Railroad Administration has been reduced to 5.8. For the week ending July 27 the percentage of bad order cars was 7.1. This shows a marked decrease and indicates an improvement which is particularly desired now.

Car Condition Reports

	Sept. 28	Oct. 5	Oct. 12
Number of roads represented	137	140	139
Total revenue cars	2,484,491	2,492,862	2,448,437
Bad order cars	149,520	145,686	142,965
Heavy repairs	89,357	85,776	84,308
Light repairs	60,163	59,910	58,657
Percentage of bad order cars	6.0	5.8	5.8
Average bad order cars repaired per working day			
Heavy repairs	97,863	94,840	92,583
Light repairs	10,737	10,203	9,922
Number of cars transferred to other shops	87,126	84,637	82,661
Number of employees	3,780	4,845	4,947
	145,328	145,242	143,902

Percentage of Bad Order Cars by Regions

	Oct. 12	Oct. 5	Sept. 28	Sept. 21
Eastern	6.3	6.4	6.7	7.0
Allegheny	7.1	6.7	7.0	7.1
Pocahontas	6.1	5.5	5.3	5.4
Southern	5.1	5.0	5.1	5.1
Central Western	5.3	5.3	5.2	5.2
Southwestern	3.2	3.1	3.1	3.2
Northwestern	5.8	6.3	6.5	6.6
All regions	5.8	5.8	6.0	6.2

SHOP EMPLOYEES' HOURS REDUCED

The emergency under which railroad employees in locomotive and car repair shops worked long hours during the war period having in some degree passed, Director General McAdoo, on November 22, issued directions under which the locomotive and car shop hours, as far as practicable, will be reduced to 9 hours per day, effective on November 25, and to 8 hours per day effective on December 9.

The director general sent the following telegram to all regional directors:

Last spring when the railroads were still struggling with congested traffic and weather conditions were very severe, the different mechanical organizations responded in a most gratifying way to the request that the men work a greater number of hours in the shops throughout the country than they had been accustomed to, or than some of their agreements with the railroads provided, in order to repair locomotives and cars for the prompt transportation of munitions of war and for food and other supplies for our army and navy abroad and the Allies. It is now possible, in view of the signing of the armistice, to anticipate an early return to normal conditions, and directions have been issued that wherever practicable the locomotive and car shop hours shall be reduced on November 25 to nine hours per day where greater number is now being worked and to basis of eight hours per day on December 9. The director general desires to express his deep appreciation of the patriotic response of the mechanical workmen on all railroads and his gratification that it is no longer necessary to call for number of hours of service heretofore required.

STANDARD LOCOMOTIVE DELIVERIES

The figures available the latter part of November indicate that a total of 514 of the United States Railroad Administration's order of 1,430 standard locomotives have been completed, consisting of 93 out of 570 from the Baldwin Locomotive Works, 409 out of 800 from the American Locomotive Company and 12 out of 60 from the Lima Locomotive Works. These figures do not include the recent order of 500 locomotives to the American Locomotive Company and 100 to Lima. Of the 514 standard locomotives built, 482 had been delivered to various roads under federal control up to and including November 23, as follows:

Atlanta & West Point	1	Eight-wheel Switcher
Atlantic Coast Line	5	Six-wheel Switchers
Baltimore & Ohio	37	Light Mikados
Central of New Jersey	10	Heavy Mikados
Central of New Jersey	7	Six-wheel Switchers
Chesapeake & Ohio	10	Heavy Mikados
Chicago & Alton	10	Light Mikados
Chicago & Eastern Illinois	15	Light Mikados
Chicago, Milwaukee & St. Paul	38	Heavy Mikados
Chicago Junction	14	Six-wheel Switchers
Cleveland, Cincinnati, Chic. & St. Louis	22	Light Mikados
El Paso & Southwestern	4	Heavy Mikados*
Erie	16	Eight-wheel Switchers
Erie	15	Heavy Mikados
Grand Trunk (Eastern)	10	Light Mikados
Lake Erie & Western	15	Light Mikados
Lehigh & Hudson River	4	Light Mikados
Lehigh Valley	5	Light Mikados
Louisville & Nashville	20	Heavy Mikados
Michigan Central	20	Light Mikados
Nashville, Chattanooga & St. Louis	4	Light Mikados
New York Central	24	Eight-wheel Switchers
New York Central	7	Light Mikados
New York, Chicago & St. Louis	10	Light Mikados
Pittsburgh & West Virginia	3	Light Mikados
Pennsylvania Lines West	5	Six-wheel Switchers
Pittsburgh, McKeesport & Youghiogheny	10	Light Mikados
Rutland	6	Light Mikados
Rutland	1	Eight-wheel Switcher
Seaboard Air Line	10	Light Mikados
Southern	25	Light Mikados
Southern	3	Eight-wheel Switchers
Texas & Pacific	11	Light Mikados
Toledo & Ohio Central	5	Eight-wheel Switchers
Toledo & Ohio Central	15	Light Mikados
Union Pacific	20	Light Mikados
Wabash	20	Light Mikados*
Western & Atlanta	1	Eight-wheel Switcher
Wheeling & Lake Erie	20	Heavy Mikados
Wheeling & Lake Erie	4	Eight-wheel Switchers

*Ten U.S.R.A. Mikado locomotives constructed for the Wabash and three U.S.R.A. Mikado locomotives constructed for the El Paso & Southwestern were sent to Cleveland to be stored as part of an emergency pool.

STANDARD CAR DELIVERIES

Of the 100,000 standard freight cars ordered by the Rail-

road Administration in April, 4,588 had been delivered up to November 14. The cars were delivered by the various car building companies as follows: American Car & Foundry Company, 1,595; Haskell & Barker Car Company, 594; Pressed Steel Car Company, 1,112; Pullman Company, 146; Ralston Steel Car Company, 191, and Standard Steel Car Company, 950. The Railroad Administration is now giving out a weekly statement of the car deliveries similar to its statement of locomotive deliveries. The combined statements for the three weeks ending November 16 show the following deliveries, amounting to 2,708:

Road	Number	Type	Manufacturer
A. C. L.	146	50-T. Comp. Gond.	Haskell & Barker
B. & L. E.	15	55-T. S. Hopper	A. C. & F. Co.
C. & N. W.	338	40-T. D. S. Box	A. C. & F. Co.
C. & N. W.	277	50-T. Comp. Gond.	A. C. & F. Co.
C. & N. W.	70	50-T. Comp. Gond.	Haskell & Barker
C. C. & O.	73	50-T. S. Hopper	Press. Steel C. Co.
C. C. & O.	76	55-T. S. Hopper	Std. Steel Car Co.
C. C. C. & St. L.	98	55-T. S. Hopper	A. C. & F. Co.
C. C. C. & St. L.	151	55-T. S. Hopper	Press. Steel C. Co.
C. C. C. & St. L.	186	55-T. S. Hopper	Pullman Co.
C. C. C. & St. L.	200	55-T. S. Hopper	Ralston Co.
C. C. C. & St. L.	200	55-T. S. Hopper	Std. Steel Car Co.
C. O. & O.	177	50-T. S. Hopper	Press. Steel C. Co.
N. Y. C.	35	50-T. Comp. Gond.	A. C. & F. Co.
N. Y. C.	198	50-T. Comp. Gond.	Press. Steel C. Co.
N. Y. C.	338	55-T. S. Hopper	Std. Steel Car Co.
N. Y. C.	81	55-T. S. Hopper	Press. Steel C. Co.
P. & L. E.	49	50-T. S. Hopper	Press. Steel C. Co.
Total	2,708		

ORDERS OF THE REGIONAL DIRECTORS

Plan of Organization of Purchasing and Stores Department.—Order 108 of the Southwestern regional director and Circular 195 of Central Western regional director outline a plan for the organization for the purchasing and stores departments as agreed to by the director of the Division of Finance and Purchases and the director of the Division of Operation of the Railroad Administration:

1. The purchasing department shall be in charge of a general purchasing agent or purchasing agent reporting direct to the federal manager, or general manager where there is no federal manager in charge.

2. The purchasing agent, in co-operation with the regional purchasing committee shall buy all material and supplies, including fuel, dining car and restaurant supplies, and sell all scrap and obsolete material, including equipment. He shall also have direct charge of the handling of scrap and the reclaiming of usable material.

3. He shall be responsible not only for the purchases and sales, but for the quantity of material on hand, the custody, care and distribution thereof, and charges therefor, and necessarily shall have charge of all material not in actual use and of the storehouses and other places where material is stored.

4. He shall be aided by and shall appoint a general storekeeper and other necessary assistants such as fuel agents, stationers, tie and timber agents and commissary agents, who shall report to the purchasing agent direct.

5. An exception as to paragraphs 3 and 4 may be made, with approval of the regional director, upon railroads where the stores department is separately organized, and now reporting direct to the federal manager.

6. All storekeepers and all others, more than half of whose time is devoted to the handling or accounting for material, shall be appointed by and be under the charge of the general storekeeper and on his payroll.

7. All appointments of purchasing agents, general storekeepers, fuel agents, tie and timber agents, shall be subject to the approval of the regional directors.

8. The regional purchasing committee with the approval of the regional director shall appoint a supervisor of stores to have general supervision over the stores department and reporting direct to the regional purchasing committee.

Working Hours of Locomotive and Car Repair Forces.—In order 106 and a circular dated October 26, the Southwestern and Central Western regional directors respectively announce a working schedule for employees in locomotive and car departments during the coming winter:

The hours for men in the locomotive department should be not less than 58 per week divided as follows: Five days of 10 hr. each, 8 hr. on Saturday. If Sunday work is found necessary, 8 hr. every second Sunday should be worked.

Such overtime as may be necessary to balance shop work for the complete repairs to a locomotive that is being turned out will, of course, be worked as usual in addition to the above hours.

Beginning November 15, the hours for car department employees should not be less than 53 per week, divided as follows: Five days of 9 hr., 8 hr. on Saturday. If Sunday work is found necessary, 8 hr. every second Sunday should be worked.

On roads which can maintain the percentage of bad order cars below four, 2 hr. per day may be worked.

A reduction in the hours of the car department forces is made because work must be done chiefly in daylight hours.

Repairs to Locomotives.—The Southwestern regional director announces that the practice of railroads repairing locomotives at their home shops, which prevailed during corporate control, will be continued as far as practicable. When the facilities are insufficient and it is desired to move engines for repairs to shops on another line under the same federal manager's jurisdiction or shops under authority of another federal manager, the approval of the regional director must be previously obtained.

Air Compressors for Locomotives.—The Southwestern regional director, in Circular 125, suggests the advisability of

AUTHORIZATIONS AND EXPENDITURES IN CONNECTION WITH WORK CHARGEABLE TO CAPITAL ACCOUNT AS OF NOVEMBER 10, 1918—CLASS I RAILROADS

Class of work (1)	1918 budget (2)	Additions to budget (3)	Work specifically authorized on D. C. E. forms 1, 2, 3 and 4, to November 10, 1918 Chargeable to— Operating expenses (4)	Capital account (5)	Expenditures from January 1, 1918, to September 30, 1918 Charged to— Operating expenses (6)	Capital account (7)	Unexpended balance Chargeable to— Operating expenses (8)	Capital account (9)
ADDITIONS AND BETTERMENTS (*Excluding Equipment*)								
Fuel stations and appurtenances	$6,090,558	$1,650,249	$1,109,456	$7,756,753	$320,188	$2,590,363	$789,268	$5,166,390
Water stations and appurtenances	13,430,047	1,706,624	1,907,836	10,672,695	573,852	4,281,751	1,333,984	6,390,944
Shop buildings, enginehouses and appurtenances	62,694,927	9,256,573	6,465,459	52,772,474	1,730,632	15,698,759	4,734,827	37,073,715
Shop machinery and tools	9,142,488	4,636,668	1,325,637	20,172,327	307,501	5,467,487	1,018,136	14,704,840
EQUIPMENT								
Locomotives, steam	$196,926,868	.....	.....	$116,650,975	.....	$51,183,399	.....	$65,467,576
Locomotives, steam, ordered by R.R. Administration	.....	.....	.....	76,873,355	.....	*23,857,762	.....	53,015,593
Locomotives, other	.....	.....	.....	2,359,213	.....	1,684,932	.....	674,281
Freight-train cars	212,858,464	.....	.....	94,716,146	.....	66,404,773	.....	28,311,373
Freight-train cars, ordered by R.R. Administration	.....	.....	.....	289,460,000	.....	*44,490,812	.....	244,969,188
Passenger-train cars	28,459,830	$155,337	.....	12,417,401	.....	8,836,325	.....	3,581,076
Work equipment	6,538,810	1,771,745	.....	7,016,124	.....	1,537,526	.....	5,478,598
Motor car and trailers	557,039	20,200	.....	587,558	.....	58,547	.....	529,011
Floating equipment	5,323,337	412,342	.....	5,129,889	.....	632,523	.....	4,497,366
Miscellaneous equipment	507,923	84,724	.....	603,677	.....	221,932	.....	381,745
Improvements to existing equipment	35,807,654	4,135,765	$19,276,960	40,421,567	$5,213,654	17,277,675	$14,063,306	23,143,892
Total equipment	$486,979,925	$6,580,113	$19,276,960	$646,235,905	$5,213,654	$216,186,206	$14,063,306	$430,049,699
Construction of extensions, branches and other lines	$20,330,489	$2,066,072	$23,836	$39,063,037	Cr. $6,576	$13,961,847	$30,412	$25,101,190
Total, all work	$941,041,902	$61,471,942	$140,400,589	$1,175,848,883	$35,483,125	$403,864,950	$104,917,464	$771,983,933

*Expenditures to date.

changing to 8½-in. cross compound pumps on heavy power when locomotives receive class 1, 2 or 3 repairs, if the cross compound pumps can be obtained. An 8½-in. cross compound air compressor will produce approximately three times as much air as will a 9½-in. simple air compressor, approximately twice as much air as an 11-in. simple air compressor, while the number of pounds of steam used per 100 cu. ft. of air is approximately one-third as much in a cross compound pump as in the simple types. The use of the compound compressor will therefore be in the interest of the maximum supply of compressed air as well as in the interest of fuel economy.

Age of Locomotives. — The Eastern regional director in Order 5001-1-A246 asks for a list of locomotives over 25 years old which are not good for efficient service. Also a list of locomotives over 20 years and less than 25 years old, the type or condition of which is such that they are not contributing to the efficiency of operation. Locomotives in either list which have been heretofore reported to the Regional Purchasing Committee for sale should be marked with an X.

RADIANT HEAT AND FIREBOX DESIGN*

Combustion Chambers Increase Furnace Efficiency and Radiation; Long Tubes Are of Little Value

BY J. T. ANTHONY
Vice-President, American Arch Company

FOR some unknown reason, most gases will neither radiate heat nor be heated up by heat rays from some other source. In order to heat a gas it is necessary to bring its molecules into actual contact with a hot body, and in order to cool a gas it is necessary to bring its particles into actual contact with a cooler body.

Burning gas, or flame, both absorbs and emits heat rays; but the instant the flame burns out and the gases become transparent, radiation ceases. This property of gases has an important bearing on firebox design.

A perfectly "black body" is one that absorbs all heat and light waves falling upon it and reflects none. In a locomotive firebox we approach very close to the ideal black body, in that practically all the heat radiated from the glowing fuel bed and flames is absorbed by the surrounding soot-covered surfaces. The amount of heat so absorbed depends upon two things: first, the area of the radiating surfaces; second, the temperature. If we increase the firebox heating surface without increasing the area of the heat radiating surfaces or their temperature, there will be practically no increase in the amount of heat radiated.

If we were using a coke or a hard coal that burns without any flame, the total amount of radiating surface would be equal to the grate area and increasing the firebox heating surface would have but little effect on the firebox evaporation. When using a high volatile coal, however, the heat radiated from the fuel bed can be disregarded, for in this case the temperature and extent of the flames becomes the controlling factor. The flames being interposed between the heating surfaces and the fuel bed, absorb the heat radiated from the fuel bed in addition to the heat being generated within the flames by the burning combustibles, and radiate this heat to the surrounding heating surfaces. It is then apparent that increasing the volume of the firebox and filling the added volume with flame results in increasing the radiating surface and the amount of heat radiated.

The installation of a combustion chamber results in an increase of both volume and heating surface, but the added heating surface is of little value if the firebox volume is not utilized and filled, or partly filled, with flame. The amount of flame in a firebox depends primarily upon the amount of combustible gas being driven off, the air supply, and the volume of the firebox.

With a fair grade of bituminous coal and ordinary firing methods, fully 50 per cent of the heat generated in the firebox is due to the burning of combustible gases above the fuel bed. In order to burn this completely it is necessary to have an excess of oxygen above the fuel bed, to mix this oxygen intimately with the combustible gases and to provide sufficient flameway or combustion chamber space. It has proved very difficult, if not impossible, to get sufficient oxygen above the fuel bed at moderate or high rates of firing, and to mix thoroughly the oxygen with the combustible gases. The brick arch has proved to be a very effective gas mixer, but the lack of air or oxygen can only be offset, or partly offset, by increasing the firebox volume by adding a combustion chamber and thereby increasing the time available for the completion of combustion.

The effect of temperature upon the amount of heat radiated is shown in Fig. 1. The points determining the curve

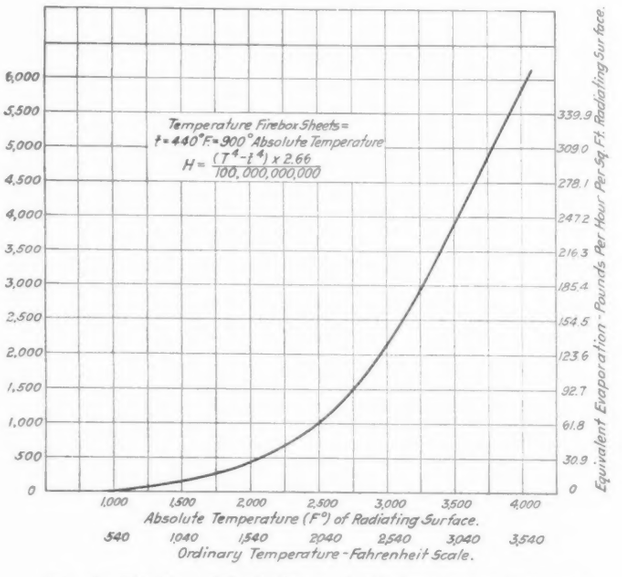


Fig. 1—Relation of Radiation and Evaporation to Firebox Temperature

have been calculated from the Stefan-Boltzmann formula, which is shown in the diagram. As shown by the curve, a little increase in temperature means a big increase in firebox evaporation.

If we know the average firebox temperature and the area of the radiating surfaces, we can approximate with a fair

*From a paper read before Central Railway Club, May 10, 1918.

degree of accuracy the total amount of heat radiated to the firebox surfaces and the amount of water evaporated by the firebox surfaces; or if we know the temperature of the gases entering the tubes and the temperature of the gases at the front end and the analyses of the gases, we can, after establishing a heat balance, calculate with a fair degree of accuracy the total evaporation from the tubes. This amount, subtracted from the total boiler evaporation, will give us the firebox evaporation.

The latter method has been used in analyzing test data from a Pacific locomotive in order to determine approximately the relative value of firebox and tube heating surfaces. The locomotive in question had a grate area of 70

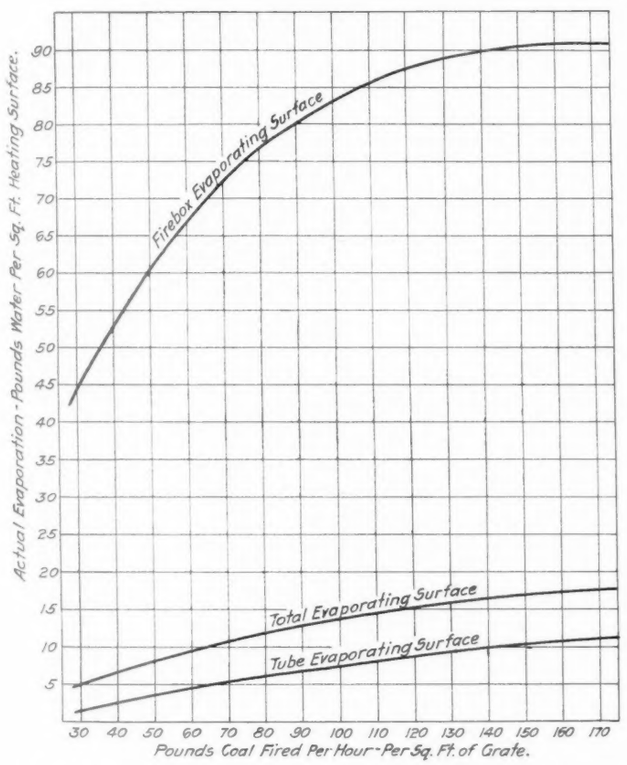

Actual Evaporation - Pounds Water Per Sq. Ft. Heating Surface.
Firebox Evaporating Surface
Total Evaporating Surface
Tube Evaporating Surface
Pounds Coal Fired Per Hour - Per Sq. Ft. of Grate.

Fig. 2—A Comparison of the Rate of Actual Evaporation for Firebox and Tube Heating Surfaces in Relation to Rate of Combustion

sq. ft., barrel combustion chamber 36 in. long, tubes 19 ft. long and 2¼ in. in diameter, total firebox and combustion chamber heating surface 307 sq. ft., and total tube heating surface 4,557 sq. ft.

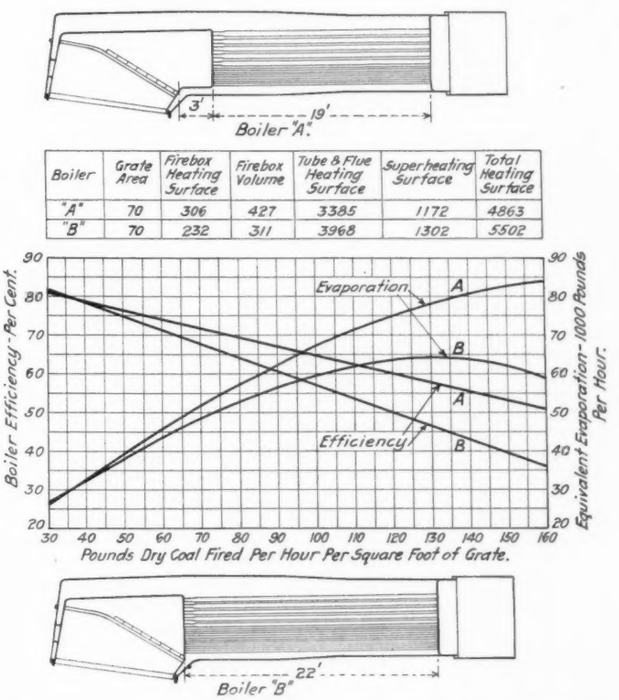
Using a formula proposed by Professors Fessenden and Haney as the result of tests on heat transmission through boiler tubes, conducted at the University of Missouri, the tube evaporation was calculated for the varying rates of combustion and these subtracted from the total evaporation to get the firebox evaporation. The results in pounds of water evaporated per sq. ft. of heating surface are shown by the curves in Fig. 2, where it will be noted that the evaporation per sq. ft. of tube heating surface varied from 1½ to 11 lbs. per hour, while the actual evaporation per sq. ft. of firebox heating surface varied from 42 to 91 lb. per sq. ft. of heating surface per hour, as the rate of combustion increased from 30 to 170 lb. of coal per sq. ft. of grate. On a basis of equivalent evaporation, the firebox absorbed from 66 per cent of the total heat at the low rates to 39 per cent at the highest rate.

The coal as fired averaged about 14,300 B.t.u., firebox temperatures ranged from 2,150 to 2,570 deg. F.; total gas per pound of coal fired varied from 14 lb. to 8 lb.

When burning 160 lb. coal per sq. ft. of grate per hour, or a total of 11,200 lb. of coal per hour, the firebox had an equivalent evaporation of 33,400 lb., while the tubes evaporated 50,800 lb., the total evaporation from the boiler being 84,200 lb. per hour. Assuming that the firebox was completely filled with flame, the flame radiating surfaces equal the firebox heating surfaces, and the equivalent evaporation per hour per sq. ft. of firebox heating surface was about 109 lb. At this rate each sq. ft. of firebox heating surface absorbed 105,730 heat units per hour; and since the effective flame-radiating surface equals the firebox heating surface, each sq. ft. of radiating surface was radiating at the rate of 105,730 heat units per hour, or 1,762 heat units per minute.

In order to radiate this much heat, an average temperature of 2,400 deg. F. was required; during the test in question the pyrometer located at the end of the arch indicated a temperature of about 2,550 deg. As this temperature reading was taken at the point where the gas area was restricted, the mixing effect most effective and the combustion very violent, the temperature would naturally be higher. A difference of 150 deg. between the temperature at this point and the average temperature of the firebox as calculated is not unreasonable.

By means of the Fessenden formula mentioned, the temperature drop of the gases passing through the tubes was calculated and from this the evaporation for each one-foot section of the tubes, using Holborn and Henning's values for the specific heat of the different gases at the varying



Boiler	Grate Area	Firebox Heating Surface	Firebox Volume	Tube & Flue Heating Surface	Superheating Surface	Total Heating Surface
"A"	70	306	427	3385	1172	4863
"B"	70	232	311	3968	1302	5502

Fig. 3—Comparison of Performance of Similar Boilers With and Without Combustion Chambers

temperatures. The resulting evaporations per one-foot section of tubes run from 8,120 lb. per hour from the first one-foot section to 620 lb. per hour in the last one-foot section; giving an equivalent evaporation per sq. ft. of tube heating surface of from 34 lb. per hour in section adjacent to firebox to 2½ lb. per hour in the section next to the front end.

The firebox was responsible for 39.7 per cent of the total evaporation, the first section of tubes evaporated 9.6 per

cent; the next section 8 per cent, and so on, gradually decreasing to the last, or nineteenth section, which evaporated only seven-tenths of one per cent of the total. The firebox and first 10 ft. of tubes evaporated 89.1 per cent of the total; the firebox and first 15 ft. of tubes evaporated 96.6 per cent of the total; while the last four one-foot sections adjacent to the front end accounted for only 3.4 per cent of the total,—and this with 19-ft., 2¼-in. tubes. These figures indicate the relative value of the different heating surface locations and show conclusively the value of combustion chamber and firebox heating surface exposed to the action of radiant heat, as compared to heating surface gained by the use of long tubes.

So far, no attempts have been made to establish a definite relation between combustion chamber length and tube lengths, or between the length of firebox from door sheet to tube sheet and length of tubes. These proportions of course should vary with the nature of the fuel used. When using bituminous coal, which constitutes the major portion of our locomotive fuel, the indications are that the firebox from door sheet to tube sheet should be approximately as long as the tubes. In some cases it could no doubt be made longer to advantage. This statement is based not solely upon the value of the different heating surfaces as shown, but also upon the fact that locomotive boiler efficiency is governed primarily by the furnace efficiency; and high furnace efficiency cannot be obtained without ample firebox volume. There is no logical reason for applying long tubes and providing large areas of heating surface before adequate provision has been made for a furnace that will burn the coal and liberate all the heat contained.

Tests conducted both in this country and abroad show clearly that nothing is to be gained by increasing the tube lengths beyond 18 ft. or 19 ft. Tests have likewise shown the advantage of combustion chambers in increasing boiler capacity and efficiency.

Fig. 3 shows the relative capacity and efficiency of the combustion chamber boiler mentioned above as compared with a similar boiler without a combustion chamber and with tubes 22 ft. long. At a rate of combustion of 40 lb. of coal per sq. ft. of grate per hour the efficiencies and capacities of the two boilers were the same; but as the rate increased the combustion chamber boiler showed a marked superiority. As shown by the evaporation curves, the boiler *B* without a combustion chamber reached its maximum capacity at a rate of combustion of 135 lb. of coal per sq. ft. of grate; while the combustion chamber boiler continued to increase in capacity even at a rate of 160 lb. This indicates that the firebox of boiler *B* could not be forced beyond a rate of 135 lb.; and even at that rate its furnace efficiency was only 62 per cent while that of the combustion chamber boiler was 74 per cent. This difference may not have been due entirely to the combustion chamber but it was due entirely to an improvement in combustion conditions which resulted in higher temperatures and increase in radiating surfaces.

The main objection urged against combustion chambers, aside from some structural details, is that they tend to reduce the temperature of the gases entering the tubes. If such a drop in temperature does occur, it not only means that the front end temperatures will be lower and the boiler efficiency will be higher, but it also shows that the combustion chamber space is being utilized for the burning of the gases.

The heat given off by the actual contact of the gases with firebox heating surface is insignificant when compared to the heat that is radiated from the flames. For instance, at a rate of combustion of 120 lb. gases entering the 36-in. barrel combustion chamber at a temperature of 2,320 deg. F. would be reduced to 2,295 deg., or a 25-degree drop in temperature, due to the contact of the hot gases with the heating surfaces. If the combustion chamber were 8 ft. long, the drop due to the same cause would be only 68 deg., so it is evident that if we have a very large drop in temperature, it is due to the heat being radiated from the flames, for transparent gases do not radiate heat. Under the same conditions and with gases entering the tubes at a temperature of 2,295 deg., there would be a drop of 600 deg. in passing through the first three-foot length of tubes and a drop of 1,200 deg. in passing through the first eight feet.

It is evident, then, that the combustion chamber heating surfaces are not arranged to take up any great amount of heat from the gases by convection or actual contact with the gases. Such heating surfaces depend almost entirely upon heat radiated from the burning gases. The instant the gases cease to burn the flame disappears, radiation ceases and there is little further drop in temperature regardless of the length of combustion chamber.

There is no logical objection to the use of long combustion chambers when burning a highly volatile fuel, and many reason why they should be used. The results of investigations made for the Bureau of Mines by Henry Kreisinger and his associates, described in Bulletin 135, relative to the combustion of gases in stationary furnaces equipped with long combustion chambers, indicate that under the conditions that generally prevail in the locomotive firebox there is little danger of getting too much firebox volume or combustion chamber space.

Boiler heating surfaces are highly efficient compared to the furnace. There are thousands of locomotives in service to-day equipped with boilers of sufficient heating surface to generate a great deal more power than they are at present doing if they could be equipped with fireboxes of sufficient grate area and volume to insure a higher furnace capacity.

FOURTH LIBERTY LOAN RESULTS

The final reports to Director General McAdoo show that the railroad men of the United States subscribed for a total of $184,868,300 in Fourth Liberty Loan bonds. This compares with $106,655,450 subscribed in the third loan, an increase of $78,121,850.

A tabulation of subscriptions by regions shows that the honors for the campaign belong to the Southwestern region, 99.1 per cent of the 170,333 employees of that region having subscribed for a total of $21,487,650, an average of $126 per subscriber. The Eastern region, the largest of the seven, naturally led in the total subscribed with $54,697,200, but its percentage of employees subscribing and the average subscription were not as high as in the Southwestern region.

The totals in detail follow:

Region	Number subscribers	Percentage employees	Amount subscriptions	Amount per subscriber
Administration Headquarters (Wash.)	1,014	100.	$502,000	$495.10
Eastern	532,173	96.	54,697,200	102.00
Southwestern	170,333	99.1	21,487,650	126.00
Central Western	307,546	96.69	36,082,850	120.58
Pocohontas	48,954	87.23	4,380,550	89.48
Southern	184,035	78.	16,253,200	88.00
Allegheny	291,985	94.86	23,611,100	80.86
Northwestern	248,165	97.92	27,853.750	112.24

Throughout the country the employees of the mechanical department made a splendid showing. In the Eastern region they contributed $17,604,850, or about one-third of the total, 97 per cent of the men in that department subscribing. In the Northwestern region 99.33 per cent of the mechanical department employees subscribed. Perhaps the best record made was on the St. Louis roads, where every one of the 40,889 employees under Federal Manager A. Robertson subscribed, the total amount being $6,665,500, or $163 per employee. The mechanical department employees subscribed more heavily than any other class of employees on these lines.

ADAPTING BAKER HEATERS TO BURN SOFT COAL

BY A. KRESSIN
Steamfitter Foreman, Chicago, Milwaukee & St. Paul

The question of using soft coal for heating passenger cars equipped with Baker heaters is important at the present time on account of the shortage of hard coal. These heaters are all designed for anthracite coal and if bituminous coal is burned in them as they stand, the smoke and gases will escape into the car. The high price of hard coal and the difficulty of obtaining it at this time led the Chicago, Milwaukee & St. Paul to investigate the possibility

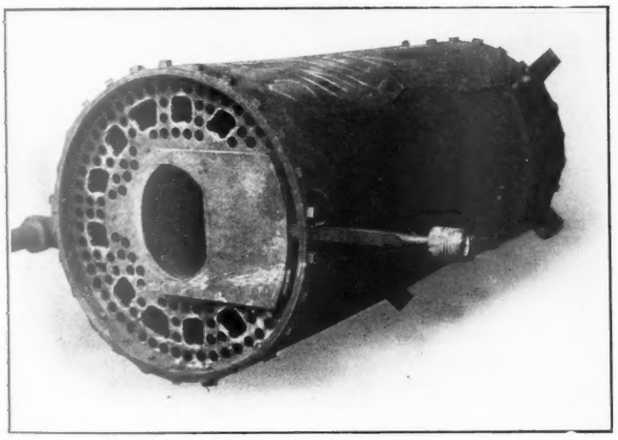


Fig. 1—Heater Drum Showing Holes Cut at the Top to Increase the Draft

of making alterations in the Baker heaters that would adapt them for burning soft coal. With this end in view extensive tests were conducted at the Milwaukee shops. A car was set out on one of the shop tracks and boarded up to prevent a change of air due to drafts around the windows.

The investigation served to show that soft coal required more draft than could be secured with the ordinary arrangement. After making numerous trials an arrangement that would burn soft coal successfully was found. The size of the stove pipe was increased from 5 in. to 7 in. diameter and it was made as nearly straight as possible. An 8½-in. pipe with 1-in. holes around the bottom was placed over the 7-in. pipe where it passed through the roof of the car, as shown in the drawing, forming a ¾-in. dead air space around the pipe. In order to improve the draft, larger holes were cut in the concave plate in the top of the heater, thus allowing the smoke to escape more readily and preventing it from entering the car proper when the upper door in the heater is open. These changes are plainly shown in the photograph.

In the old style heaters a sheet iron smoke screen was installed operating on the same principle as the screen in the fireproof heater. Large holes were also cut in the cast iron top between the smoke flues and the smoke screen, to improve the draft, as shown in the drawing.

In order to allow the heated air and gas to escape from the heater rooms, a 10-in. ventilator was placed in the roof with a pipe leading through the roof and the ceiling. A sheet iron plate with a number of ½-in. holes punched in it was set in the door of the heater room to give more air. The size of this plate was varied to suit the construction of the door.

When using soft coal in Baker heaters, care must be taken to prevent over-heating on account of the free burning character of soft coal as compared with hard coal. The coal must not be allowed to arch over in the firebox but should be kept down on the grates at all times. A large poker should be kept inside the heater room for this purpose. If these precautions are closely followed, soft coal can be burned without danger of fire. Several tests have been conducted to determine how long the fire could be held in these heaters with soft coal. One or two buckets of coal were first put in and after sufficient time had elapsed to allow the fire to become well established, the heater was filled to the top with coal and the fire was checked by closing the lower and opening the upper door. In this way the fire has been maintained for five days and nights without putting in additional coal. No gas or smoke was found in the car. By following the methods described above, soft coal can be burned without

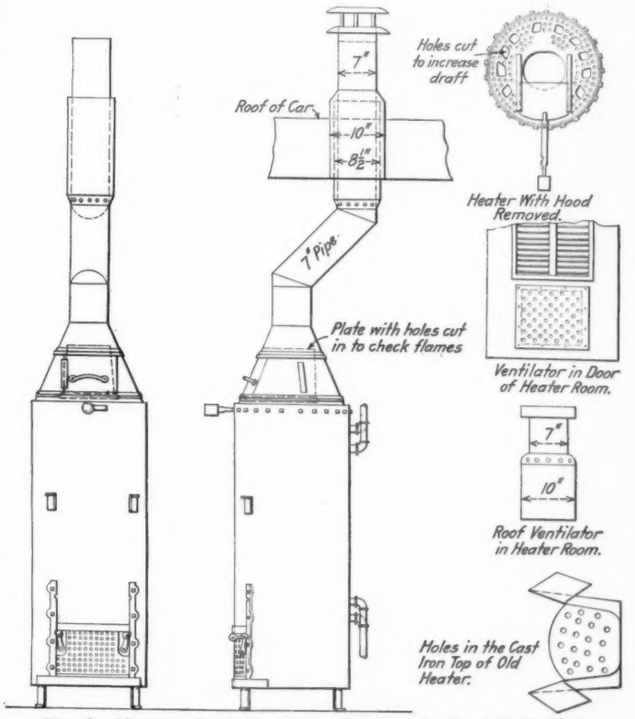


Fig. 2—Changes Made In Baker Heaters to Burn Soft Coal

danger from fire, thus eliminating the trouble of carrying a stock of hard coal to supply passenger cars and resulting in a considerable saving. The Baker heaters on the Chicago, Milwaukee & St. Paul are being changed as fast as possible to burn soft coal.

PISTON TRAVEL AND BRAKING POWER*

BY H. F. WOOD
Supervisor Air Brakes, Boston and Maine

In brake operation the piston travel is of such importance that the unequal condition in which it is found varies every operation of the brakes in so far as power is concerned. This is not alone all that it does. It varies the time required to obtain the braking power expected to be had from a given brake pipe reduction, or we can go still further and say that it is possible to get several times the braking power on one car as compared to another, due wholly to the variation in piston travel. With these conditions, which we must allow exist, all can see what it means to brake manipulation as far as producing shocks is concerned, and it is a condition over which the engineer does not have full control. We can go still further in this direction and add that it is these varying conditions that produce excessive braking power on some cars and little or none on others, both of which produce shocks due to the surging of the train, and flat wheels, due to cars being pulled or bumped off their "feet," as well as damage to the lading.

In order to show what difference the different lengths of piston travel make in brake cylinder pressures and braking power on loaded and empty cars, providing no brake cylinder leakage was present, the following tables are given. They will explain in a simple way, the causes of trains bunching or stretching when the brakes are applied.

TABLE NO. 1

Train Pipe Reduction (Lb.)	Piston Travel (In.)	Cylinder Pressure	Cylinder Value	Percentage of Braking Power Empty Car	Percentage of Braking Power Loaded Car
10	4	52.5	2,650	63	17.06
10	5	41	2,050	49.2	13.06
10	6	33	1,650	39.6	11.
10	7	27.5	1,375	33.	9.16
10	8	23	1,150	27.6	7.6
10	9	19	950	22.8	6.33
10	10	16	800	19.2	5.3
10	11	13	650	15.6	4.3

TABLE NO. 2

Brake pipe reductions necessary to produce equalization of pressures with piston travel varying from 4 inches to 11 inches.

Piston Travel (In.)	Equalization of Pressures (Lb.)	Brake Pipe Reduction (Lb.)
4	59	11
5	57	13
6	55	15
7	53.5	16.5
8	51.5	18.5
9	50	20
10	49	21.5
11	47	23

Similar tables to these could be made for any other brake pipe reductions. As a result it can be readily seen that if in a train some brake cylinders have long piston travel and some short, a very uneven braking power will be developed for any and all brake pipe reductions.

Let us see what effect this unequal distribution of braking power has. Suppose that two cars are coupled together, each having a light weight of 35,000 lb., with the standard 8-inch equipment, the first car having 11 inches piston travel and the second car 4 inches. If a full service application is necessary to stop the two cars, a brake pipe reduction of a sufficient amount must be made to equalize the brake cylinder and auxiliary reservoir pressures of both equipments, which will be 23 lb., although 11 lb. would be sufficient for the second car. Therefore, 12 lb. of brake pipe air is wasted from the second car. However, the second car obtained a cylinder pressure of 59 lb. while the head car only obtained a cylinder pressure of 47 lb.

Let us suppose now that these two cars be arranged to furnish 60 per cent braking power with 50 lb. cylinder pressure; 59 lb. in the cylinder of the second car represents 70.8 per cent while 47 lb. in the head cylinder represents 56.4 per cent, and 70.8 per cent braking power on the second car equals 24,780 lb.; 56.4 per cent braking power on the first car equals 19,740 lb. As a result, the stopping power on the second car is 5,040 lb. greater than on the head car and a draw bar pull of this amount is present throughout the stop.

Let us look at this situation from another point of view. Suppose that a 10-lb. service reduction was made. This would produce a cylinder pressure of 52.5 lb. in the second car and a cylinder pressure of 13 lb. in the first car. The percentage of braking power on the second car would equal 63 per cent or 22,050 lb., while the percentage of braking power on the head car would only equal 15.6 per cent or 5,460 lb. In this case a draw bar pull between the two cars during the application would equal 16,590 lb. or nearly three times more braking power on the second car than on the first one.

It is evident from this that a uniform piston travel is most desirable. If it is long, the brake cylinder pressure is thereby reduced and the efficiency low; further, a greater quantity of air is consumed in brake applications than would otherwise be necessary, entailing greater demands upon the air compressor. If the piston travel is too short, it is liable to cause the brake shoes to drag upon the wheels when brakes are released, and by too high a cylinder pressure, with the possibility of wheel sliding and rough stops when brakes are applied.

Now consider for a moment what the results are from the difference in the cylinder pressures and the time in which it is obtained with the varying piston travels, and at the same time think over the difference in the braking power on the empty and loaded cars.

I believe then, that you will allow first, that the only salvation against shocks and break-in-twos is either to let the train drift to a stop or keep the train bunched or stretched when making stop and by all means make the initial brake pipe reduction light in order that only a low braking power be developed until the slack has adjusted itself, and under no circumstances release the brakes unless the slack and speed conditions permit, until stop is made.

It is the practice of many railroads to haul the loads ahead and the empties behind. This is in my opinion better than handling them in the reverse order, for in case of trouble with the empties behind the result is generally a parting of the train, while with loads behind the result is the opposite and the buckling of the train takes place.

In order to avoid the great difference in braking power on account of the variation in weight of train at any section, it would be better to alternate them, thereby avoiding the great difference in braking power. A better method however, is to handle loads and empties in different trains. This creates switching and will no doubt be considered out of the question. Nevertheless, we have got to look at and work to better the situation. The proposition is before us and it reduces itself to the following: First, switching; second, inspection; third, maintenance, and fourth, instructions.

Break-in-twos are caused by greater braking power at the rear than at the forward part of the train, and is a separation and not a collision. The damage generally is not great. The sudden bunching or buckling of the train is caused by greater braking power at the head end. This may be responsible for a bad accident, not only on the train on which it occurs but to others in the opposite direction, on double track roads.

*From a paper presented before the New England Railroad Club.

STANDARD U. S. R. A. REFRIGERATOR

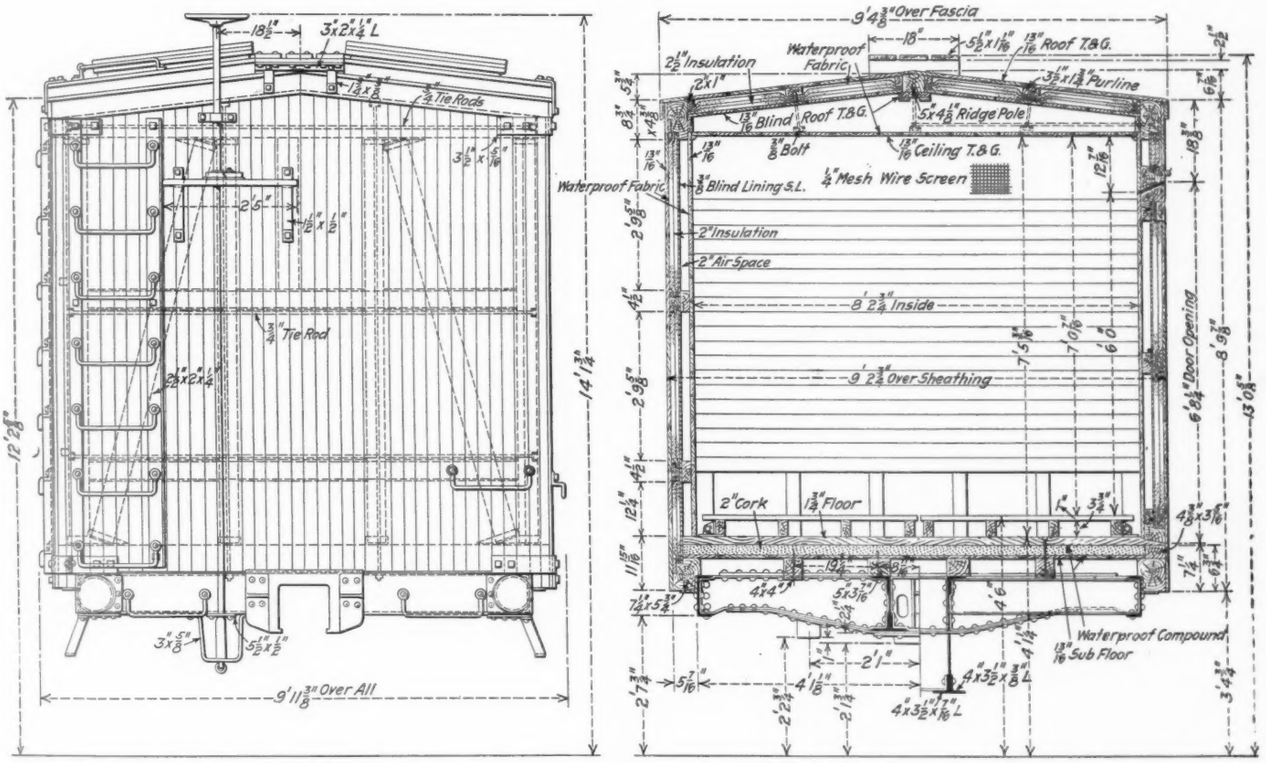
Latest Practices Followed in Design; Ice Baskets, Solid Insulated Bulkhead and Steel Underframe

THE mechanical department of the United States Railroad Administration has recently issued Mechanical Department Circular No. 7, covering repairs to freight cars, which is based on the designs for a standard refrigerator car made by the Railroad Administration. The circular states: "In order to insure the greatest possible degree of efficiency in refrigeration and conservation of foodstuffs, refrigerator cars having trucks of 60,000 lb. capacity or over will, when receiving general repairs or being rebuilt, be made to conform to the United States standard refrigerator car requirements." The circular requires that the general arrangement of the cars be as near as practicable to that shown on drawing No. 1386. The ice boxes to be in accordance with drawing No. 1389, the hatch arrangement in accordance with No. 1390 and the floor and walls in accordance with drawing No. 1387, all of which are shown in connection with this article. Other details of these cars have been prepared and may be obtained from Frank McManamy, assistant director, Division of Operation, in Washington. These cover:

Hatch plug hinge (Dr. 1606)
Hatch plug hinge strap (Dr. 1607)
Hatch plug lifter guide (Dr. 1608)
Hatch cover hinge (Dr. 1609)
Hatch cover lever (Dr. 1611)
Hatch plug lifter (Dr. 1613)
Hatch hinge butt (Dr. 1614)
Hatch cover lock lever guide (Dr. 1615)
Hatch plug lift ring (Dr. 1630)
Hatch cover lever anchor (Dr. 1653)
Hatch hinge pin (Dr. 1731)
Well trap cone (Dr. 1610)
Door locking rod (Dr. 1639)
Locking rod back plate (Dr. 1649)
Side door locking rod socket (Dr. 1654)
Side door locking rod socket (Dr. 1655)
Side door step (Dr. 1656)
Side door seal pin keeper (Dr. 1657)
Side door seal pin (Dr. 1658)
Well trap (Dr. 1616)
Well trap cover (Dr. 1617)
Drain pipe (Dr. 1604)
Floor racks (Dr. 1644)
Floor rack hinge plate (Dr. 1724)
Floor rack hinge loop (Dr. 1726)
Floor rack link holder (Dr. 1727)
Floor rack pin bearing (Dr. 1728)
Floor rack bearing (Dr. 1729)
Floor rack hinge pin (Dr. 1732)
Door arrangement (Dr. 1391)
Side door hinge (Dr. 1623)
Locking rod guide (Dr. 1635)
Side door lock arm (Dr. 1659)
Seal hook and chain (Dr. 1664)
Door open fastener (Dr. 1675)
Clip for door open fastener (Dr. 1676)
Link for door open fastener (Dr. 1677)
Door hinge pin (Dr. 1730)

The railroads are requested to send to the Mechanical Department, Division of Operation, at Washington, blueprints of the cars that do not meet the specifications, with the following information:

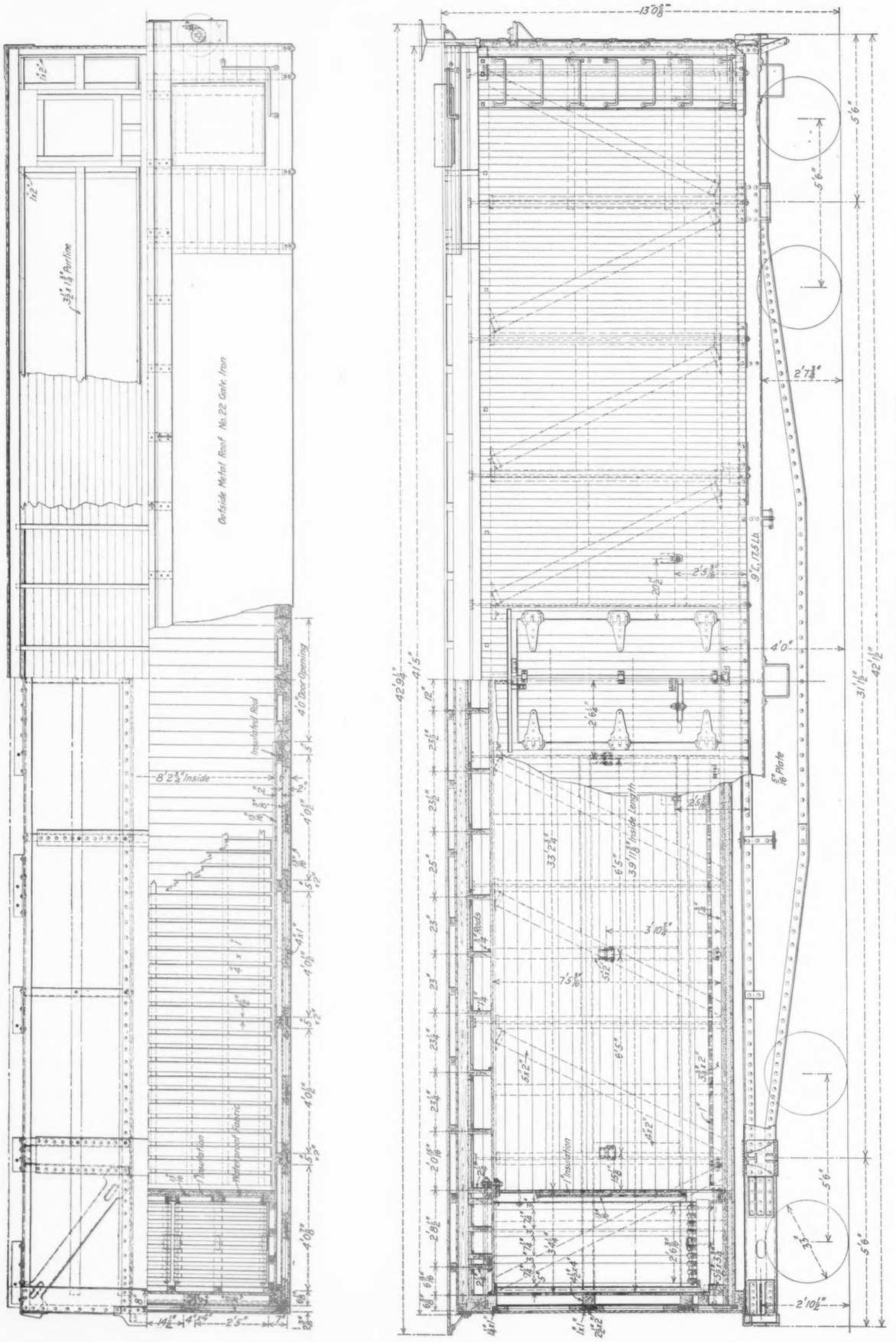
(a) Number of cars owned that will need to be changed to meet the requirements.
(b) Estimated cost of making the changes.
(c) Location of shops where cars will receive such changes.



End Elevation and Section of U. S. R. A. Standard Refrigerator Car (Drawing No. 1386)

(d) Number of cars that can be changed monthly at each shop.
(e) Number of cars that can be changed in all shops per month.
(f) Length of time that it will require to make changes on all cars owned.

The circular further states that in order to improve refrigeration of cars as at present constructed, all railroads owning refrigerator cars will immediately arrange to apply floor racks in accordance with drawing No. 1387, where they have not already been so equipped. It is desired to have all refrigerator cars requiring such racks equipped within the next twelve months; therefore, there should be no delay in beginning this immediately. Monthly reports will be furnished to the general supervisor of car repairs, Washington, D. C., showing the number of cars equipped

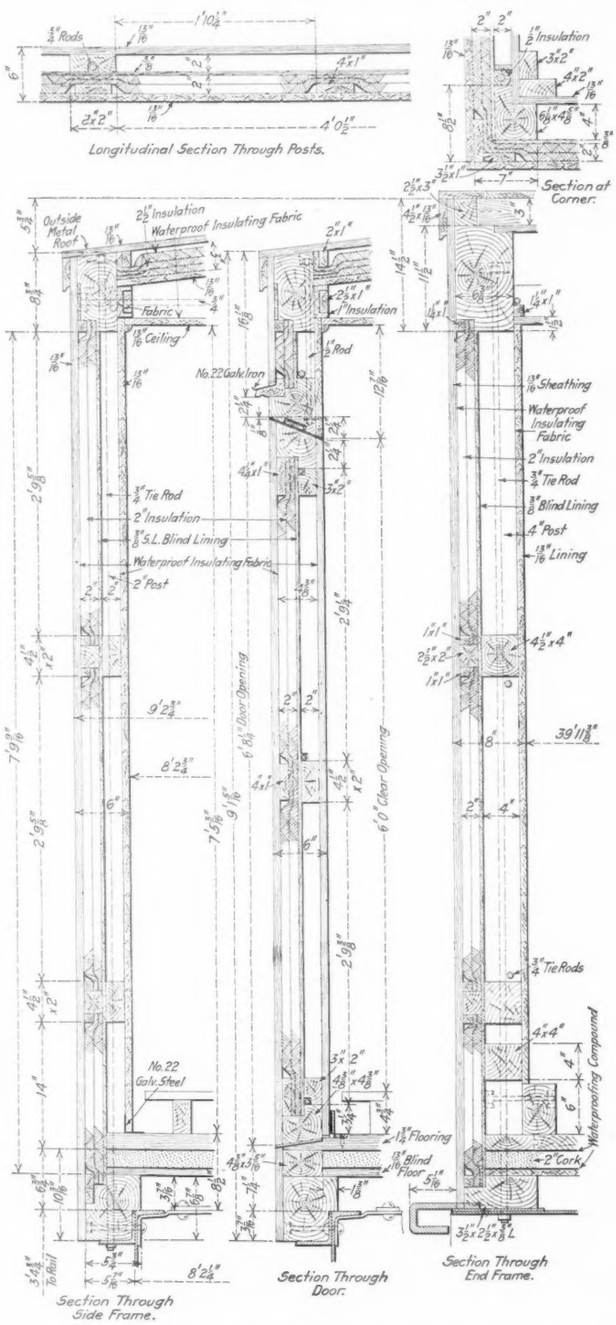


Elevation and Plan of U. S. R. A. Standard Refrigerator Car (Drawing No. 1386)

with floor racks, those equipped with similar racks and the number remaining to be equipped.

DESCRIPTION OF THE STANDARD REFRIGERATOR CAR

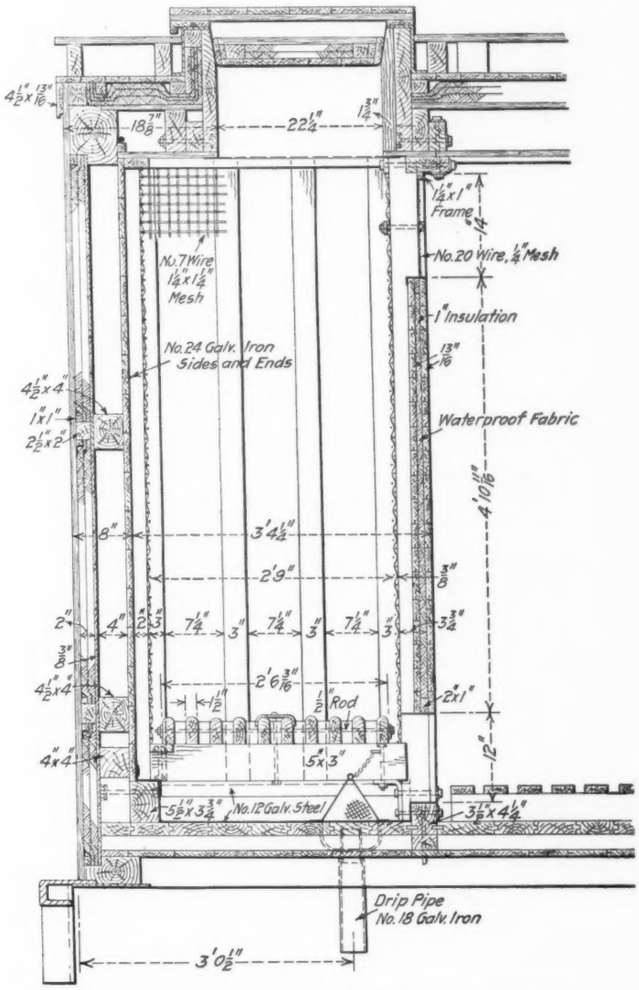
The specification (No. 1386) for the standard refrigerator car calls for a car of 30-ton capacity with a steel underframe, ice compartments at each end with stationary insulated



Standard Refrigerator Car Sections Showing Insulation (Drawing No. 1387)

bulkheads and ice receptacles of the basket type. These cars are made to conform as nearly as possible to other standard type cars. Many of the parts of the air brake rigging, the body center plate, body side bearing, side bearing and truck clearances, draft gear details, limiting dimensions for couplers and several other minor details are the same as those used in the other standard cars constructed for the Railroad Administration. The lumber sections are the same as used on the standard box cars.

The cars are to be equipped with the Westinghouse KC 10-12 type air brakes, of either Westinghouse or New York Air Brake Company's manufacture, with 25-50 double pressure spring type retaining valve of the Westinghouse Air Brake Company's design. Braking power to be about 60 per cent of the light weight of the car, based on 50 lb. cylinder pressure. The piston travel is to be between 5 in. and 7 in. Friction type draft gear is specified, having a minimum capacity of 150,000 lb. and a maximum travel of 2¾ in. The clearance between the coupler horn and striking

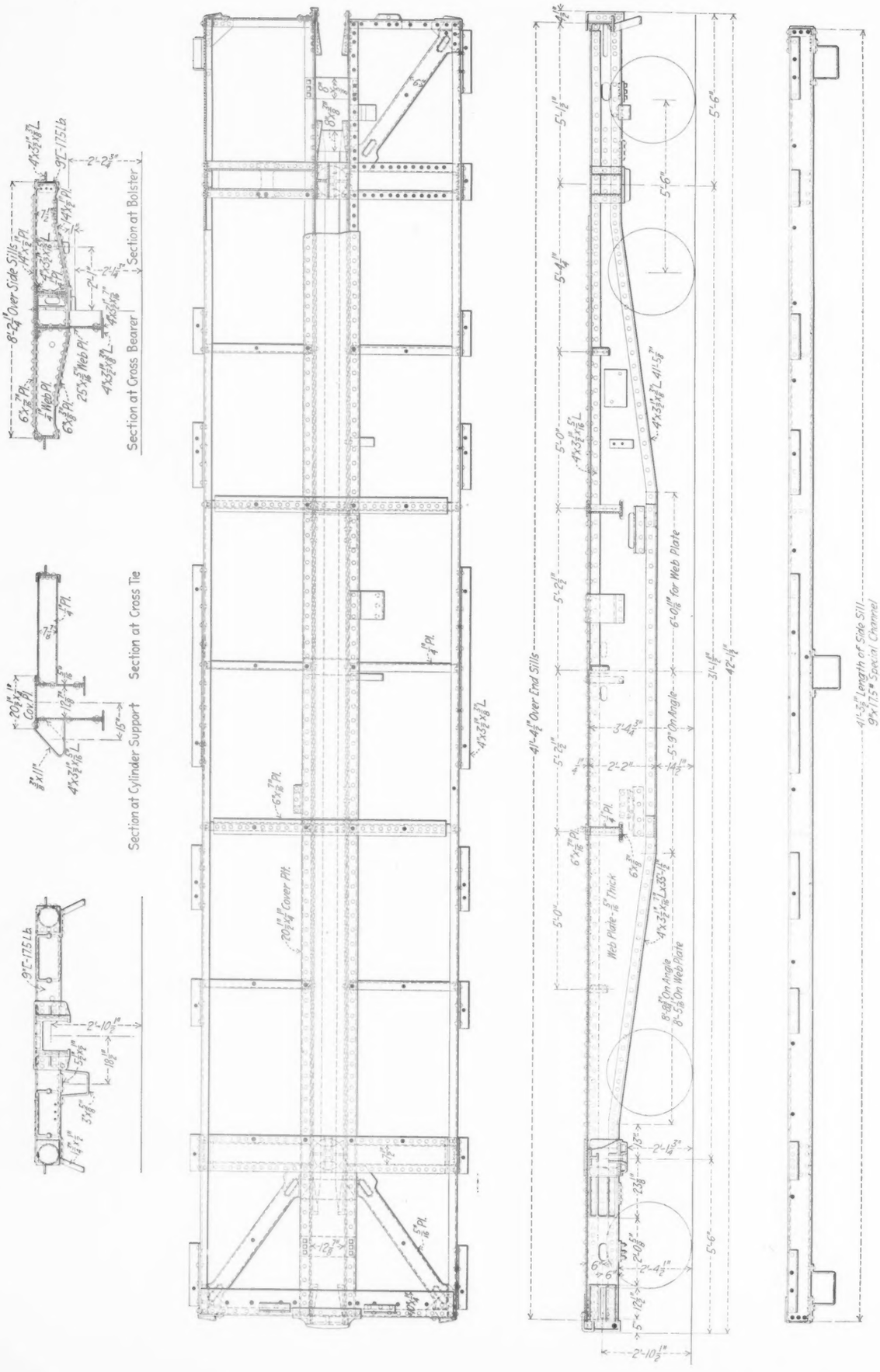


Arrangement of Ice Box for Standard Refrigerator Cars

plate to be 3 in. As in all other freight cars the Chicago, Murray, Sessions type *K*, Westinghouse or Miner draft gears may be used. The cars have the following general dimensions:

Length outside, between end linings	39 ft. 11⅜ in.
Length inside, between bulkheads	33 ft. 2¾ in.
Width inside	8 ft. 2¾ in.
Height inside, floor to ceiling	7 ft. 5⅛ in.
Height inside from floor grates to ceilings	7 ft. 1/16 in.
Length over striking plate	42 ft. 1½ in.
Width over eaves	9 ft. 5⅛ in.
Width over-all (side ladders)	9 ft. 10¾ in.
Height from rail to top of car at eaves	12 ft. 2⅝ in.
Height from rail to top of brake mast	13 ft. 6¼ in.
Height from rail to top of running board	13 ft. ⅝ in.
Distance center to center of trucks	31 ft. 1½ in.
Height from rail to center of coupler	2 ft. 10½ in.
Height from rail to bottom of center sill	2 ft. 4½ in.

The framing of the car is made up of 7¼-in. by 5¾-in.



Underframe for U. S. R. A. Standard Refrigerator Car (Drawing No. 1388)

side sills, mortised to fit the angle on the side sill member of the underframe. There are 12 intermediate 5-in. by 2-in. side posts and 12 diagonal braces of the same material. There are two side belt rails 4½ in. by 2 in., located 2 ft. ¼ in. and 4 ft. 10 in. above the bottom of the side sill, respectively. The side plate is 8¾ in. by 4¾ in. There are two intermediate 4-in. by 4-in. end posts and two end belt rails 4½ in. by 4 in. The corner posts are 6⅛ in. by 7 in. The roof framing consists of a ridge pole 5 in. by 4⅛ in. and two purlines 3½ in. by 1¾ in., with 1¾-in. carlines having ¾-in. tie rods located at every other carline. The end plates are 6¼ in. by 8 in., gained out to receive the insulation. The door posts are oak members 13/16 in. by 3¼ in. The roof has 13/16-in. roof boards which are covered with a No. 22 gage outside metal roof. The inside and outside sheathing of both the sides and ends is 13/16 in. thick. The inside of the cars is provided with a floor rack of 1-in. by 4-in. boards fastened to four 3¾-in. by 2 in. stringers. The floor racks are hinged at the sides.

UNDERFRAME

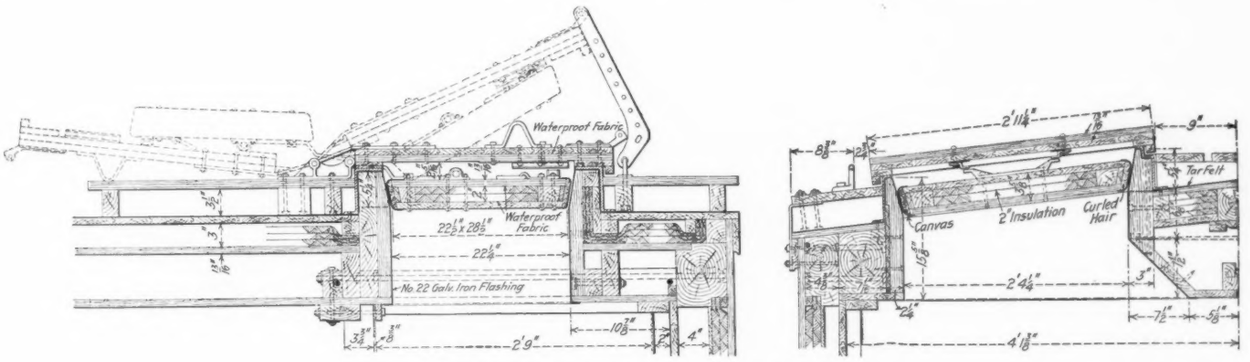
The underframe center sill is of the fishbelly type, being made up of two 5/16-in. web plates located 12⅞ in. apart, 25 in. deep at the center and having at the top 4-in. by 3½-in. by 5/16-in. angles and at the bottom 4-in. by 3½-in. by ⅜-in. angles on the outside and 4-in. by 3½-in. by 7/16-in. angles on the inside of the plate. There is a 20½-in. by ¼-in. cover plate extending the full length of the car between the end sills. The side sills are 9-in., 17.5-lb. channels with 4-in. by 3½-in. by ⅜-in. angles riveted to them to support the wooden side sills of the car body. The end sills are channels of the same section as the side sills. The crossbearers are made of ¼-in. pressings with 6-in. by 7/16-in. top cover plates and 6-in. by ⅜-in. bottom cover plates. The body bolsters are built up of ¼-in. pressings with a 6-in. by 7/16-in. top cover plate and a 6-in. by ⅜-in. bottom cover plate. The diagonal braces at the corner of the car are made of 5/16-in. plate pressed to channel section.

INSULATION

The specifications call for two courses of 1-in. insulation in the sides and ends and three courses with a combined thickness of 2½ in. in the roof. The floor insulation is of pure cork board 2 in. thick. An option of hairfelt, Keystone hairfelt, flaxlinum and linofelt is provided for the insulation. The side walls of the car consist of an inside sheathing 13/16 in. thick, to which is applied on the outside a layer of waterproof insulating fabric. This sheathing is fastened to two belt rails 4½ in. by 2 in., a 2-in. air space thus being provided. To the outside of these belt rails is nailed a ⅜-in. shiplap blind lining, on which is applied waterproof insulating fabric, the 2 in. of insulation, another layer of waterproof insulating fabric and the 13/16-in. outside tongued and grooved sheathing. The ends are substantially the same with the exception of the thickness of the belt rails and air space, which is 4 in. The section through the door is precisely the same as that through the sides. No break is made in the insulation around the corner posts. The waterproof insulating fabric is of No. 350 drill, which is a cotton cloth weighing approximately 3½ lb. per 100 sq. ft. and thoroughly saturated with an odorless waterproofing compound, preferably of an asphaltic base of approximately the same consistency of waterproof compound used on insulating paper. It extends continuously from side sill to side plate and from door post to door post around the end of the car.

The flooring is made up of a 13/16-in. blind floor at the bottom, a layer of waterproofing compound on top of this, then a layer of 2-in. cork insulation, another layer of waterproofing compound and a 1¾-in. tongued and grooved floor with the joints white leaded. The quantity of waterproofing compound used in each of the two layers is 30 gal., and the specifications for this material require that it must be perfectly waterproof, having a melting point of not less than 175 deg. F.; it must be pliable at zero, highly adhesive when hot, not sticky when cold, and absolutely odorless.

The roof is made up of a 13/16-in. ceiling, on which is laid a layer of waterproof insulating fabric. A blind roof 13/16 in. thick supports three layers of insulation, having a total thickness of 2½ in., on which is laid a layer of the waterproof insulating fabric. A slight air space is left between this and the roof boards, which are 13/16-in. thick. An outside metal roof is to be applied on top of this. A layer of ½-in. insulation 4 in. wide is mortised into the side plate at the outside for the full length of the car in order to provide insulation at points where the carline tie rods pass through the side plate. On the outside a 1-in. layer of insulation is applied in the air space between the ceiling and the blind roof, being folded over and held in place by a 2½-in. by 1-in. nailing strip.



Sections Through Ice Box Hatch for Standard Refrigerator Cars

ICE COMPARTMENTS

An ice compartment is located at each end of the car. They have stationary insulated bulkheads and an ice receptacle of the basket type. The distance from the outside end of the car to the inside face of the bulkhead is 4 ft. ¼ in., the distance between the bulkheads being 33 ft. 2¾ in. The bulkhead is made up of two layers of tongued and grooved 13/16-in. boards, with a layer of 1 in. insulation between them, and it is supported by four intermediate 3-in. by 3¾-in. oak posts. The opening at the top of the bulkhead is 14 in., having a No. 20 wire ¼-in. mesh galvanized screen. The opening below the bulkhead is 12 in. The ice basket is a screen made of No. 7 wire with 1¼-in. by 1¼-in. mesh, which is galvanized after weaving. There is a space of 2 in. between the basket and the walls of the ice compartment. The inside dimensions of the ice basket are 2 ft. 9 in. deep by 7

ft. 10 in. wide and 6 ft. 3 3/16 in. high. A 4-in. air space is provided between the wall of the ice box and the end of the car. As in the sides, the end consists of 3/8-in. shiplap sheathing with two 1-in. layers of insulation and a 13/16-in. outside sheathing. The ice is supported on 3-in. by 1½-in. oak grates, which are carried on six 5-in. by 3-in. wooden members. The sides and the ends of the ice box are covered with No. 24 galvanized iron for the full height of the box. The drip pan is made of No. 12 galvanized steel with the sides and the ends flanged upward.

The ice hatch has an opening 22¼ in. by 2 ft. 4¼ in. The hatch frame is 1¾ in. thick, supported at the ends by suitable cripples and filling blocks on the inside to substantial blocking extending across the full width of the car and at the outside by a filler block between it and the side plate. In addition to this there is a malleable iron frame 5/16 in. thick and of Z-section, which extends around the upper portion of the hatch. The inside of the hatch passage is covered with a flashing of No. 22 galvanized iron. The hatch plug is made up of two layers of 3/16-in. boards with two 1-in. layers of insulation between them. It is attached loosely to the hatch cover in such a manner that it may freely fit the hatch without binding, but yet so that it can be raised with the cover.

None of these cars have been ordered by the Railroad Administration up to the present time.

PASSENGER CAR CLEANING*

BY E. ELEY

Master Car Builder, Canadian Pacific, Eastern Lines, Montreal, Que.

Cleaning passenger equipment cars is one of the operations all railways have to expend large amounts of money for yearly, and clean cars is one of the things the traveling public appreciates. Those of us who travel know this from the remarks we hear from passengers. Very few of them, however, know what a vast amount of labor must be spent to keep them clean and in a sanitary condition.

In this paper I will endeavor to conduct them through a train just arriving from a five days' trip across the continent. We will start at the rear end and walk through, noting its condition. If it is in the dry season and ties have been put in the track recently, we have dust covering everything, and it has got into the plush seat covering, carpets and bedding. Besides this, there is the usual amount of paper, orange peel, bottles, etc.

Before we can start our cleaning we find some of the cars are due to be fumigated, which is done once a month; upper berths have to be opened, and blankets, pillows, berth curtains and mattresses spread out so that the fumes will penetrate every part of the equipment, locker doors and toilets must be opened and all windows and ventilators closed. For an ordinary fumigation one sheet is used, saturated with formaldehyde and hung up in the centre of the car; the car is then closed up, locked and left for at least one and one-half hours, after which it is opened and ventilated for the cleaners to go in. For a thorough fumigation, which is used in cases of actual infection, three sheets are used saturated with formaldehyde and hung up, one in each end, and one in the centre of the car, and the car left closed at least three hours. After this it may be opened and ventilated.

From sleeping cars, the carpets, bedding, seats and seat backs have to be removed from the car for cleaning and airing. To clean these, the following is the usual practice: Blankets and berth curtains are shaken, mattresses are beaten or blown with air, seats and backs are either blown with air or vacuum cleaned. The carpet is first swept off and then blown with air. All this equipment is then laid on racks until the interior of the car is cleaned thoroughly and made ready to receive it again.

*Abstract of a paper presented before the Canadian Railway Club.

The interior of the car is cleaned from the headlining to the floor. First we have to get rid of the dust, deck sash are opened and dust wiped out with a disinfectant solution in the water, dust is got out from between and above the window sash by hammering with the hand, and window sticks covered with a cloth. When we have got down all the dust we can, the floor is swept out. We start again at the headlining and wash it, including the deck sash down to the deck sash rail. All the woodwork below this has to be wiped down, and if necessary washed with Castile soap and warm water, and finally the floor and steam pipes are washed with a disinfectant solution in the water; this includes toilets, under the washstands and lockers. Now it is ready to receive the bedding, etc. When this is stowed away, seats and backs are replaced. The woodwork is gone over and polished, sometimes using a renovator; nickel and mirrors are all cleaned and polished, the carpet is laid, and the final finishing touches are given to the car. Passage ways and vestibule floors are scrubbed and a canvas strip laid down and left there until the train is ready to back into the station. This work takes about 35 hours, and with the exception of washing the headlining and polishing the woodwork where a renovator is used, is performed by two men and a woman, and costs about $15.50 per car.

This work is performed on observation, sleeping and tourist cars once in seven days, or in the case of Transcontinental trains they are stripped at Montreal or Toronto and Vancouver, which is once in six days. On shorter runs the cleaning given this equipment between strippings is an ordinary cleaning, consisting of sweeping carpets, dusting and wiping woodwork, cleaning windows, mirrors, nickel, etc., and finally vacuum clean the cushions, backs and carpet, scrubbing floors in passage ways, and vestibules.

We will now take the day coaches. We do not remove seats or seat backs from them, windows are opened and the car is swept out, then dusted down, headlining washed if necessary, floor and steam pipes scrubbed with a disinfectant solution, and if necessary all, or part of the interior, washed down, windows, mirrors and nickel cleaned and polished, seats and backs in the first class cars are vacuumed and the aisle strip cleaned with air, and the car is ready for service. If cars are cleaned in the morning and do not leave until night, they quite frequently have to be dusted again just prior to departure.

We now come to the baggage and express cars. The fish racks are lifted and pits swept out, and then rack and pits scrubbed with clean water without disinfectant, then pits and racks are sprinkled with lime and racks replaced. As necessity requires, these cars are washed down from roof to floor. Being on the front end of trains they get very dirty from smoke from the locomotive. The reason we do not use disinfectant in the water for scrubbing baggage cars is that it would taint some of the commodities carried in them.

Mail cars are cleaned in the same way, except that the floors are scrubbed with disinfectant in the water. This completes the inside cleaning. The outside is cleaned by washing or wiping, according to weather conditions, but the best results are obtained by wiping when it is possible to do so. The windows are occasionally gone over with a little muriatic acid in water whenever necessary to cut the dirt or scum which accumulates, and then washed with clear water; vestibules and steps are wiped down and the brass work polished. This is an ordinary cleaning which the cars receive every time they are in the terminal, but even with this cleaning, in two or three months they become so dirty that the numbers cannot be seen. Then they are given a terminal cleaning which consists of scrubbing them with some approved cleaner and thoroughly washing it off, and the car looks as though it had only just come out of the shops.

We have now gone over the work which has to be performed. Let us take a look at the people who perform it. They are composed of all nationalities, some of whom do make

pretty good car cleaners and others of whom never will. This then is the element with which we have to get this work done, and you can readily see it requires the closest supervision to get it done properly.

I once saw a woman who was on the terminal cleaning and using our standard cleaner put her brush into some fine sand and start to scrub some spots on the outside of the car to remove some excretia which had become dried on so hard that it was almost impossible to remove it without taking off the varnish. This woman was a foreigner and no doubt in the country she came from the practice was to use sand and water to scrub the floors. You can readily understand what it means to educate such people and make car cleaners of them.

To supervise work of this nature requires men of energy and patience, and like the people working under them, require special training, otherwise the class of cleaning deteriorates, then it becomes necessary to make a crusade for better cleaning, and some of our foremen will tell you this occurs quite frequently.

M. C. B. CIRCULAR ON AIR BRAKE MAINTENANCE

The necessity for improvement in the condition of air brake equipment on freight cars has led the Master Car Builders' Association to issue an appeal for closer observation of the interchange rules and standards of the association. At the suggestion of the executive committee a joint meeting of the Committee on Train Brake and Signal Equipment, representatives of the Fuel Conservation Section of the Railroad Administration, and the president of the Air Brake Association was recently held and recommendations for improving the maintenance of air brakes were prepared. These recommendations have received the approval of the United States Railroad Administration and are now being issued as Circular No. 20, which reads as follows:

Conditions throughout the country point to the fact that air brake equipment on freight cars is in need of closer attention than is now being given, and that the Rules and Instructions of the Association regarding air brake maintenance and repairs are not being fully observed. Your attention is called to this matter with a view of bettering operating conditions, and the following is recommended:

First:—That the instructions of the Association covering repairs, cleaning and inspection of freight car train brakes be more rigidly enforced. In this connection, it is suggested that these rules, which are shown on pages 474 to 477, inclusive, of the 1917 Proceedings of the M. C. B. Association, be printed by each road in the form of a circular and posted under glass at each repair and inspection point.

Second:—Interchange Rule No. 60 provides that, "Air brakes bearing cleaning marks nine months old, or older, may, when on repair or other tracks where the work can be done, be cleaned and repaired," and charged to car owner. Inasmuch as inspection shows that the brakes on a great many cars are not now being cleaned, even in twelve months, it is recommended that wherever possible they be cleaned at the expiration of the nine months' period.

Third:—That all roads not equipped with the standard triple valve test rack and the standard air brake hose coupling gage, procure them as soon as possible.

Fourth:—That the number of brakes cleaned yearly by each road should equal or exceed the number of cars owned.

Fifth:—That special attention be given to maintaining brake pipe, brake cylinder, reservoir, retaining valve and pipe secure to the car.

Sixth:—That angle cock and cut-out cock should have operative handle with proper clearance.

The standards of the M. C. B. Association provide for thorough inspection and repairs to the air brake apparatus every twelve months. The unfortunate conditions existing at present could not have occurred had these standards been adhered to. In order to bring the instructions before the men actually doing the work, the Association has had the rules referred to in the second paragraph of the circular printed in large, clear type. It is hoped that the roads will post copies framed under glass at all points where air brakes are repaired to remove any possible excuse for failure to live up to the instructions due to lack of familiarity with their provisions. These rules are given in full below.

CLEANING AND LUBRICATING TRIPLE VALVES.

The triple valve should be removed from the car for cleaning in the shop, and should be replaced by a triple in good condition. It should be dismantled and all the internal parts, except those with rubber seats and gaskets, cleaned with gasoline, then blown off with compressed air and wiped dry with a cloth.

The slide valve and graduating valve must be removed from the triple piston and retarded-release parts from the body in order that the service ports in the slide valve and other parts may be properly cleaned. No hard metals should be used to remove gum or dirt or to loosen the piston-packing ring in its groove. The feed groove should be cleaned with a piece of wood, pointed similar to a lead-pencil. Bags or cloth should be used for cleaning purposes rather than waste, as waste invariably leaves lint on the parts on which it is used. In removing the emergency-valve seat, care must be exercised not to bruise or distort it.

Particular attention should be given the triple-piston packing ring. It should have a neat fit in its groove in the piston, and also in the triple-piston bushing; once removed from the piston, or distorted in any manner, it should be scrapped. The fit of the packing ring in its groove and bushing and the condition of the bushing should be such as to pass the prescribed tests. The graduating stem should work freely in the guide nut. The graduating spring and the retarded-release spring in retarded-release triple valves must conform to standard dimensions and be free from corrosion. The thread portion of the graduating-stem guide should be coated with oil and graphite before reapplying it to the triple cap.

The triple-valve piston and the emergency valve must be tested on centers provided for the purpose to insure their being straight. The emergency-valve rubber seat should invariably be renewed unless it can plainly be seen to be in first-class condition, which is seldom the case. A check-valve case having cast-iron seat should be replaced with a case having a brass seat. The cylinder-cap gasket and check-valve case gasket to be carefully examined and cleaned with a cloth; but should not be scraped. All hard or cracked gaskets to be replaced with new ones. Standard gaskets as furnished by the air-brake manufacturers should be used. The use of home made gaskets should be avoided, as the irregular thickness results in leakage and causes triple-piston stem to bend or break.

The tension of the slide-valve spring should be regulated so that its contour be such as will bring the outer end ⅛ in. higher than the bore of the bushing when the outside end of the spring touches the bushing when entering.

Before assembling the parts after cleaning, the castings and ports in the body of the triple valve should be thoroughly blown out with compressed air, and all parts of the triple not elsewhere provided for known to be in good condition. Lubricate the seat and face of the slide valve and slide valve graduating valve with high-grade very fine, dry graphite, rubbing it onto the surface and the upper portion of the bushing where the slide-valve spring bears, so as to make as much as possible adhere to and fill up the pores of the brass, leaving a very thin coating of free graphite. The parts to be lubricated with graphite must be free from oil or grease.

Rub in the graphite with a flat-pointed stick, over the end of which a piece of chamois skin has been glued. At completion of the rubbing operation, a few light blows on the slide valve will leave the desired light coating of loose graphite.

The triple-valve, piston-packing ring and its cylinder should be lubricated with either a light anti-friction oil or a suitable graphite grease as follows: Apply a light coating to the packing ring and insert the piston and its valves in the body, leaving them in release position, then lubricate the piston cylinder and move the piston back and forth several times, after which remove the surplus from the outer edge of the cylinder to avoid leaving sufficient lubricant to run on the slide valve or seat while the valve is being handled or stored ready for use. No lubrication is to be applied to the emergency piston, emergency valve or check valve.

All triple valves, after being cleaned or repaired, must be tested, preferably on a rack conforming to the M. C. B. design and pass the test prescribed under the subject of "Triple Valve Tests" before being placed in service. Should any of the triple-valve bushings require renewing, such work should be done by the air-brake manufacturers. Triples in which packing rings are to be renewed, slide valve or graduating valves renewed or faced, if the latter are of slide type, should be sent to a central point or general repair station for repairs. When applying the triple valve to the auxiliary reservoir, the gasket should be placed on the triple valve, not the reservoir.

LUBRICATING AND INSPECTION OF THE BRAKE CYLINDERS.

First, secure the piston rod firmly to the cylinder head, then, after removing the non-pressure head, piston rod, piston head and release spring, scrape off all deposits of gum and dirt with a putty knife or its equivalent, and thoroughly clean the removed parts and the interior of the cylinder with waste saturated with kerosene. Packing leather must not be soaked in kerosene oil, as it destroys the oil filler placed in the leather by the manufacturers, opening the pores of the leather and causing it to become hard. Particular attention to be paid to cleaning the leakage groove and the auxiliary tube. Triple valve must be removed when the auxiliary tube is being cleaned. The expanding ring when applied in the packing leather should be a true circle and fit the entire circumference, and have an opening of from 3/16 to 1/4 in.; when removed from the cylinder the ring opening should be 1½ to 1 9/16 in., and with this opening, of course, will not be a true circle.

A packing leather which is worn more on one side than the other should be replaced with a new one of uniform thickness, or turned so as to bring the thin side away from the bottom of the cylinder. The piston should be turned each time the cylinder is cleaned. In putting a packing leather on piston, it should be so placed as to bring the flesh side of the leather next to the cylinder walls. Follower studs to be firmly screwed into the piston heads, and the nuts are to be drawn up tight before replacing the piston.

The inside of the cylinder and packing leather to be lightly coated with a suitable lubricant, using not more than 4 oz., nor less than 3 oz. per cylinder. Part of the lubricant should be placed on the expander ring and the adjacent side of the packing leather, thus permitting the air pressure to force the lubricant into the leather at each application of the brake. No sharp tools should be used in placing the packing leather into the cylinder.

After the piston is entered, and before the cylinder head is replaced, the piston rod should be slightly rotated in all directions, about three inches from the center line of the cylinder, in order to be certain that the expanding ring is not out of place. In forcing the piston to its proper position in the cylinder, the packing leather will skim from the inner walls of the cylinder any surplus lubricant that may have been applied. It has been found good practice to again extract the piston and remove the surplus lubricant.

All stencil marks to be scraped off or painted over with black paint. The place of cleaning, day, month and year to be stenciled with white paint, preferably on both sides of the cylinder or auxiliary reservoir, or if it is not readily visible, in a convenient location near the handle of the release rod. The bolts and nuts holding the cylinder and reservoir to their respective plates and the latter to the car, to be securely tightened.

The brake cylinder to be tested for leakage after cleaning, preferably with an air gage, which can be done by attaching the gage to the exhaust port of the triple valve before connecting the retainer pipe, or where the latest type retainers are used the gage can be connected to the exhaust port of the retaining valve. In either case, the gage will indicate cylinder leakage on releasing the triple valve after making an application, and when attached to the retainer valve it will also test the retainer and retaining-valve pipe. Brake-cylinder leakage should not exceed five pounds per minute, from an initial pressure of 50 lb.

Each time the triple valve and the brake cylinder are cleaned, the brake pipe, brake-pipe strainer and branch pipe should be thoroughly blown out and the triple-valve strainer cleaned before recoupling the branch pipe to the triple valve. If a dirt collector is used, the plug should be removed, the accumulation blown out and the threaded portion of the plug coated with oil and graphite before replacing. All union gaskets should be made of oil-tanned leather. The use of rubber in unions should not be permitted. Piston travel should be not less than six nor more than eight inches.

ADDITIONAL INSPECTION AND REPAIRS TO CARS.

When the brake cylinder and triple valve are cleaned, the following additional work should be done to the car: Retaining valve cleaned by removing the cap, wiping or blowing out all dirt and seeing that the valve and its seat are in good condition, the retaining position exhaust port open and the valve proper is well secured to the car in a vertical position, pipe clamps applied where missing and tightened where loose, hose and angle cocks turned to their proper position. Pipe joints, air hose, release valves, angle and stop cocks should be tested by painting the parts with soapsuds while under an air pressure of not less than 70 lb., preferably 80 lb., and defective parts repaired or removed.

See that there are no broken or missing brake shoes, brake beams or foundation brake gear, and if the car belongs to a foreign road, a repair card should be made out covering all work that has been done, as per M. C. B. Rules.

The inspection and repairs which have been mentioned should be made to all cars at least once in twelve months.

Locomotive Situation Throughout the World.—British engine shops during the war were put to work on munitions and ordered to build no more locomotives, which would seem to leave America a free hand outside of Britain and her "possessions." Germany is expected to be busy with her own domestic needs. France, always short of locomotives before the war, had five of her six plants in territory ravaged by the Germans. Belgium's eight plants have been dismantled by the Germans. Austria bought most of her locomotives in Germany. Russia's shops have fallen before the enemy and the Bolshevists. Holland, Denmark and Norway bought in foreign markets. Italy manufactures merely enough for her own needs, as Japan does. No engine works of consequence are in the Balkans, and none of modern type in Turkey. Every railroad in South America is short of locomotives. Asia and South Africa are in a like position. It would seem but a question of when the world can begin reconstruction. And that would seem in its turn to hinge somewhat on finance.—*New York Evening Post.*

SHOP PRACTICE

BILLERICA RECLAMATION PLANT

BY B AND B

More and more during recent years the railroads of the country, seeking for new methods of increasing income and reducing expenditures, have realized the great importance of the so-called "scrap pile" and of the necessity of realizing from materials discarded as unfit for use a greater value than is received when sold as common scrap, or of reclaiming discarded materials for use again on the road. In order to obtain such results reclamation plants have been erected and equipped with machinery and tools to do this work, and one of these plants recently installed is the $50,000 plant of the Boston & Maine erected at the new Billerica shops location.

Scrap Dock with Gantry Crane—Boston & Maine Reclamation Plant

The plant is modern and well equipped, consisting of an open scrap dock, which is served by a 15-ton Gantry crane, a new valuable-scrap house, and the reclamation building itself. The latter is 170 feet long by 28 feet wide and contains the following machinery:

2 100-lb. steam hammers.	2 blacksmiths' fires.
1 1½-in. bar iron shears.	1 500-lb. steam hammer.
2 triple head bolt-threading machines.	1 engine lathe.
1 6-spindle nut tapper.	Other minor equipment.

These machines, whose use can be determined from their names, are primarily and solely used for the reclamation work itself. On the open dock the equipment is: An alligator shear with a 30-in. blade, driven by a 35 h.p. motor and capable of cutting stock up to 3½-in. square at the rate of from 25 to 30 cuts per minute; one tumbler for cleaning second-hand nuts, washers and other material that would be benefited by this process; and one coupler rivet cutter which is operated by air and which has a cylinder 18½ in. in diameter and 20 in. long.

The new valuable-scrap house is 77 ft. long and 28 ft. wide. It is partitioned off into bins or compartments for the sorting of brass, copper, also brass and copper turnings from the shop, lead, secondhand plush from cars, rubber and discarded rubber hose of all kinds, burlap, hemp rope, and other valuable scrap which is classified separately from wrought iron or cast iron, etc.

The largest item of equipment in connection with the reclamation plant is the 15-ton gantry crane, which operates over the entire dock, including one track for cars on each side of the platform. This crane has a spread of 80 ft. and has a trackage of 1,079 ft. It is equipped with a No. 5 type "SA" lifting magnet, the diameter of which is 55½ in.

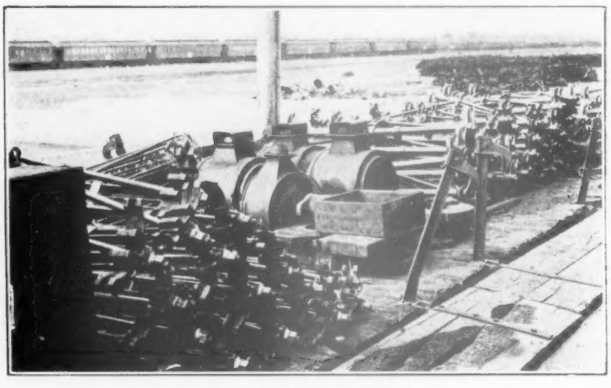
This magnet has a lifting capacity of 42,000 lb. when handling material such as billets and slabs properly piled. Other equipment in connection with the crane includes a skull-cracker ball weighing 6,300 lb., to be used for breaking up large castings for scrap. The motor on the crane or the crane runway is rated at 27 h.p., and the motor on the trolley travel is 7½ h.p. All motors used are equipped with solenoid brakes.

The scrap material received in cars is removed by the use of the magnet into a sorting bin, where it is sorted in different classes, and that which is to be reclaimed removed and sent to the reclaiming building. The assorted scrap

Scrap as It Is Received at Billerica

is placed in tilting buckets made from old fireboxes, and when these buckets become filled the contents is deposited into the proper bins containing scrap of a particular class, or dumped into cars that are being made up for shipment. The latter method is one that will be followed in all cases where possible, as this eliminates one handling and thus reduces the cost and time of handling.

Scrap from a greater part of the system is forwarded to Billerica, and there the foreman of the plant, with the aid of an inspector of materials, inspects it and determines whether or not it is fit for service again. As much as 3,000 tons have been handled in one month. The method of handling material on the outside scrap dock is carefully watched, in order that in the process of reclaiming any equipment

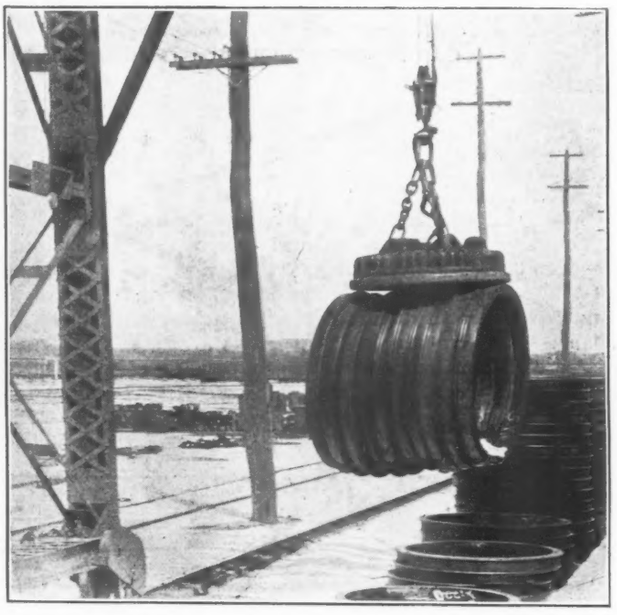


Reclaimed Brake Beams

the profits to be gained by this method may not be lost in excess of labor or time used.

The men employed at the Billerica plant are listed as follows: Ten laborers on the open dock, seven laborers in the bolt yard, four men on brake beams, one machinist, one machinist's helper, one blacksmith, one blacksmith's helper, one laborer on the bench for miscellaneous stripping, one man to handle reclaimed material. When the blacksmith is not working on brake beams, he is employed repairing fire hooks, brake rods and levers. The laborers are given their board and room. The hours of labor are 10 hours per day and seven days a week.

The principal parts which are reclaimed are bolts, nuts, washers, brake beams, globe valves, pipe fittings of all



Electric Magnet Hoisting Tires—15,000 lb. Total Weight on Crane Hook

kinds, drawbars and center pins, track shovels, formerly thrown away when the handles were broken, and ¼-in. plate which was heretofore sold as scrap but which is now, when the pieces are large enough, cut to sizes required and used as freight runs. As many as 83 Buffalo No. 2 brake beams and 294 Diamond special brake beams have been reclaimed in one month at a net saving of about 50 per cent in the cost price. A like saving was made in the reclamation of 215 double fire hooks, one hoe, 22 flash bars and 13 single hooks, in one month's time. Couplers are stripped of their parts and the good parts are saved and the remainder sold as scrap. By the adoption of this method of handling scrap a saving of 30 per cent of investment of plant is estimated. The expenditure has been moderate but the outlook promises big results.

RAILROAD MACHINERY CATALOGUES WANTED.—A representative of the Federated Swiss Railroads has asked the Zurich consulate general to obtain catalogues for him from the American manufacturers of mechanical iron rail saws, boring machines for iron railroad rails and wooden railroad ties, mechanical spike pullers, apparatus for carrying and laying iron rails, machines for drawing together rails at joints in tracks, railroad gang cars, propelled by hand and with motor attachment. He informed this office that heretofore all machinery and tools for the Swiss railroads have been obtained from America through agents in Germany, who can no longer supply these needs. For this reason he wishes to place his orders in America or with agents that American manufacturers might appoint in Switzerland. The representative of the Swiss railroads surmises that improvements have been made in the past few years by American manufacturers of this class of machinery, and he is particularly interested in hearing about these.

ACCURACY IN LOCOMOTIVE REPAIRS

Methods of Making and of Fitting New and Repair Parts for Locomotives With Gages and Micrometers

BY M. H. WILLIAMS

MANUFACTURING concerns making machine tools and similar products are continually giving more and more attention to the question of standardizing their product and making the various parts closer to certain prescribed limits. This is done not as a matter of sentiment, but principally on account of being a good business proposition, it having been found that where the various parts that go to make up the completed machine are properly made for size, grade and finish, the cost of assembling is very much reduced. In many respects railway shops can adopt to advantage the good practices, the machine tools, and the methods that have proved economical in manufacturing concerns.

Many of the railway shops have been established a long time and the older methods of performing work have been retained, owing, partly, to the difficulty of procuring modern machines, and also to the fact that they are engaged largely in repair work which does not lend itself to standardization like new work. However, even for repair work it is possible to adopt standard sizes that will eliminate to a great extent the individual fitting of parts that go to make up a locomotive and by the use of later developed machine tools, the grade of finish of the various motion parts, especially the bearing surfaces, may be made equal to the best practices in any shop. Below are mentioned a few methods that are worthy of thought for repairing locomotives and making of new parts.

INTERCHANGEABLE AND OVERSIZED PARTS

It is generally conceded that all parts of the same classes of locomotives and cars should be interchangeable and so made that the various pieces will go together without individually fitting each to some other part. This will make it possible to manufacture and finish the various articles in large batches to gages or micrometer calipers with the assurance that they will properly fit into the place intended. This is largely done for new locomotives and cars and follows the general practices of the builders.

Repair work presents a much more complicated problem on account of the necessity for fitting new parts to holes or surfaces where wear has taken place and where the new part must be a certain amount larger or smaller than the original. However, even for repair work a certain amount of interchangeability may be obtained that will eventually result in reducing the amount of individual fitting. For certain locomotive parts, such as link motion, knuckle pins and their bushings, crosshead pins and various other motion parts, it is possible and entirely practical to establish a system for repair work of what might be called, for want of a better name, oversize standards or step sizes, by which parts for repair work may be finished a definite amount larger or smaller than standard or drawing size and gaged with micrometers or solid gages with the assurance that the parts will fit properly. That is, instead of fitting each link motion pin or similar article to the place where it is to go, they may be fitted to gage or to micrometer readings, or a combination of both. As an illustration, the taper hole in a crosshead may be reamed and the size measured with a taper gage and the pin ground or finished separately to a female gage. The gages for the taper hole and pins are a simple proposition, as will be explained later. The straight holes and pins to fit them will require a greater number of gages, or in many cases the micrometer calipers may be used.

The explanation of the step sizes can best be illustrated by an example. Assume that the hole in a motion lever bushing is called for two inches in diameter on the drawings. When the bushing is worn it is advisable when making repairs and from a shop standpoint to enlarge the hole to a certain step size, which may readily be done. In the event of a small amount of wear this enlargement may be to 2.010 in., or in the event of greater wear to 2.020 in., 2.030 in., etc., or by greater step to 2.020 in., 2.040 in., etc. This method is followed in place of finishing to no particular size, which would make it necessary to fit the pin individually to each hole. If the hole and pin are each finished to gages it will not be necessary to try the pin in the hole previous to final assembling, which will simplify the operations of fitting these parts.

MICROMETER CALIPERS

Mention has been made of these instruments. They are now gradually being introduced into railway shops and where used invariably result in improvement in the accuracy of the finished article. They also have a good effect on the workmen, as practically every one endeavors to make his work right and takes pride in it. No difficulty will be experienced in getting the men to use them where necessary when the heads of the various departments properly explain their use and the method of reading. If in doubt concerning the use of micrometers it would be well to compare the accuracy and number of good and rejected parts in shops working with and without micrometers. The use of these instruments will naturally be limited to the measurements of articles that are to accurately fit other articles and for locomotive work should be used principally on motion parts, such as link motion pins, crosshead pins, journals, etc. Their use on rough work, such as locomotive frames and parts, where close fitting is not essential, is not contemplated or necessary.

STEP SIZES FOR REPAIR WORK

For the over or under-size step sizes necessary for repair work and with the use of micrometers it is advisable to depart to a certain extent from the regular units of measurement such as 1/64 in., 1/32 in., etc., and adopt easily remembered and read decimals, such as .005 in., .010 in., .020 in., etc. This will simplify the use of micrometers. As has been explained, if the original hole is two inches the next enlargement can to advantage be 2.010 in., instead of 2 1/64 in. This does not signify that a departure should be made from drawing sizes such as one inch, 1⅛ in., 1¼ in., etc., but rather that where a hole was originally one inch, the next enlargement should be by steps of .010 in. or .020 in., up to the largest size usually allowed for enlargement. Should this enlargement of a 1-in. hole equal 1⅛ in., it will be found advisable to start again from that size with the step sizes.

Another point is also well worth consideration. This is a standard method of making the male or female part to a standard size. If the nominal size for a valve motion pin and bushing is two inches, one or the other should be made to a standard gage or size and the other part larger or smaller, as may be necessary. Generally speaking from a

shop standpoint, it is advisable to make the hole to a standard size, such as 1½ in., 1¾ in., 2 in., etc., and for a pin to fit freely in the hole a trifle below size, which may be, say, 0.004 or 1.496, 1.746, 1.996 in. By this method standard sizes of plug gages and reamers may be used, and for force fits the male portion can be made the required amount larger than the standard sizes.

MEASUREMENT METHODS

Gages for Measuring Holes.—For measuring the comparatively small holes, such as are found in valve motion parts, three inches and under, an inside micrometer may be used and is preferred by some. However, for the general run of work, solid cylindrical plug gages will be found the more serviceable. For larger parts, such as side rod knuckle pin bushings, side rod brass bushings, or holes above three inches in diameter, the tubular inside micrometer will be found the more desirable where miscellaneous measurements are to be made. Where parts are made in duplicate quantities on machines, the solid gage is to be preferred. The solid plug gages may be purchased from gage makers, but if difficulty is experienced in obtaining the odd sizes they may be made at a reasonable cost in railway tool rooms. In the latter event they should be made from tool steel hardened, or soft steel and heavily pack casehardened. In either event they should be carefully ground to size after hardening. The customary form of plug gage is shown in Fig. 1.

Measuring Outside Diameters.—For measuring the diameter of the straight portions of valve motion lever pins, crank pins and similar work, the outside micrometers will be found very convenient and accurate and much cheaper

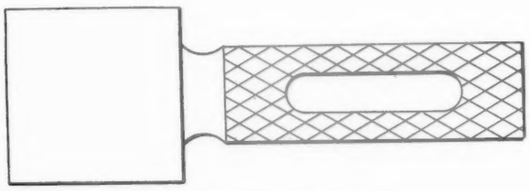


Fig. 1—Standard Plug Gage

than the solid gages that would be required to cover a large range of sizes such as are encountered in repair work. They have the advantage that any size within their range, which is generally one inch, may be measured, and where a pin is to be a certain amount smaller than the hole to allow for running fit, this amount may be measured accurately. That is, for the 2-in. size, the pin may be required 1.997 or 1.996 in., or as found satisfactory from experience.

Gaging Taper Holes.—For gaging the taper holes in valve motion levers, side rods, crossheads, frame bolt holes, etc., taper gages illustrated in Figs. 2 and 3 will be found very satisfactory. They can be used for measuring the diameter of the reamed holes and checking the accuracy of reaming, and also for detecting wear in the parts as they come to the shop. The gage in Fig. 2 shows the sizes stamped on a flattened surface. Different methods of marking at the lines are followed. One method is to mark with an arbitrary number that will indicate the number of pins or bolts that will be required. In many respects it is advisable to mark at the lines the actual diameter of the gage at that point in inches and decimals of an inch, such as 2.000, 2.010, 2.020, etc. By this method the diameter of the large end of the pin or bolt will be indicated by the reading on the gage. Where pins or bolts are marked and put in stock, and in order to avoid too much stamping, the inch marks may be omitted and simply marked 10, 20, 120, etc., the full inch being understood.

Fig. 2 shows in a general way a gage suitable for measuring taper holes such as are found in valve motion levers and ranging from 2 to 2.240 in. at the largest part of the lever jaw, the taper shown being one inch per foot and with steps advancing by .010 in. in diameter. That is, at each line the gage is .010 in. larger in diameter. The first or 2-in. diameter line is shown four inches from the small end of the gage, this extra length being for the purpose of fitting into the hole of the smaller side of the jaw. The spacing of these lines may readily be calculated and for this particular case is .120 in. These divisions may readily be cut on a milling machine, preferably with a V-shaped cutter having a sharp cutting edge. As these gages will often be

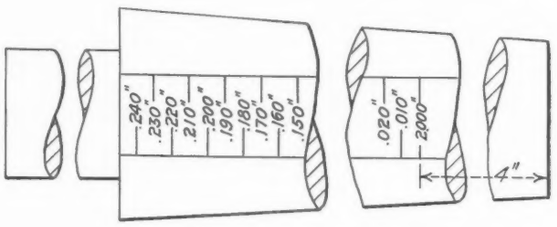


Fig. 2—Taper Gage for Small Holes

used where the light is not good, the lines may with sufficient accuracy be 1/32 in. wide. The figures stamped on the gage should also be prominent and may to good advantage be from 1/8 to 3/16 in. high. Many a good gage has been discarded because the workman was unable to read the markings properly in dark places. It is advisable to mark this form of gage for the standard dimensions called for on drawings for new work by the letters *S T D*. This will call attention to the drawing sizes for particular pins.

Fig. 3 shows a similar gage of larger diameter and for the purpose of reducing weight may be made hollow with the wall about 3/8 in. thick. These gages may be made cheaply from machine steel or old axles and when finished from 1/32 in. to 1/16 in. large they may be ground to the proper size after being heavily pack casehardened. In a number of cases where gages are used only occasionally they can to good advantage be made from cast iron and will last a long time.

For new work this form of gage will answer for gaging the reaming of holes to drawing sizes and when trying them they should enter to the line marked *S T D*. When re-

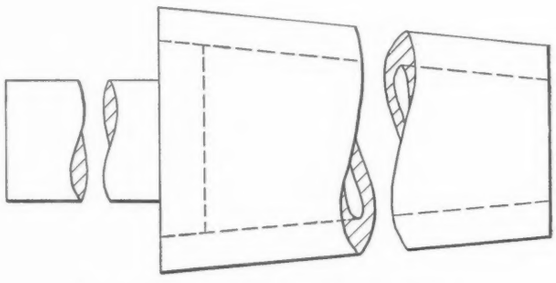


Fig. 3—Hollow Taper Gage for Large Holes

reaming worn holes they may be enlarged only enough to allow the top face of the part to come flush with one of the lines on the gage. The size stamped on the gage will indicate the size of the pin necessary to fit the hole.

Gages for Taper Pins.—For measuring the taper portion of the pin a gage as shown in Fig. 4 will answer very well. This may be used to gage the diameter of pins used for new work, in which event the diameter of the hole at the large end should equal the standard diameter of the pin. This may be gaged by the male plug gage for holes, previously

mentioned. This gage may also be used for gaging pins for repair work that are larger than standard. In this event the pin will only partly enter the gage, as shown in Fig. 5, and will serve only to test the taper and not the size.

Where these pins are ground on cylindrical grinding machines with properly trued grinding wheels and the angle of the table properly set, as may be determined by the gage shown in Fig. 5, the diameter may be measured by micrometer calipers by taking the readings over the large end of the taper, shown at *A*. The finished size should be the same as shown by the readings at the lines of the taper plug gage previously mentioned. By this method the pins will fit

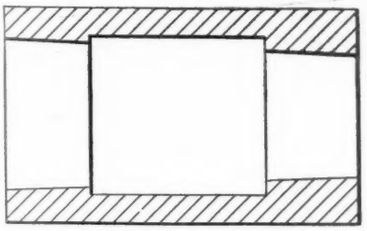


Fig. 4—Gage for Tapered Pins

properly into holes that have been reamed to the plug gage and the necessity for testing each pin in the place where it is to go will be avoided.

Gages as shown in Fig. 4 are preferably made from tool steel, hardened and ground for the smaller sizes. For the larger sizes, such as are used for piston rods, crosshead and knuckle pins, cast iron is often used, which answers very well.

METHODS OF FITTING

By the use of the cylindrical and internal grinding machines, gages and micrometers, such as have been mentioned, the following methods of making repairs to valve motion levers, side rods, crossheads, etc., and the bushings and pins used in connection with them, may be followed:

First.—Straight holes such as found in bushings and in levers not worn enough to warrant repairs of new parts. These may be tested with the plug gages to ascertain if they are to standard size or to any of the step sizes above the standard.

Second.—Same parts as above, slightly worn, which may be refinished on the internal grinding machine without re-

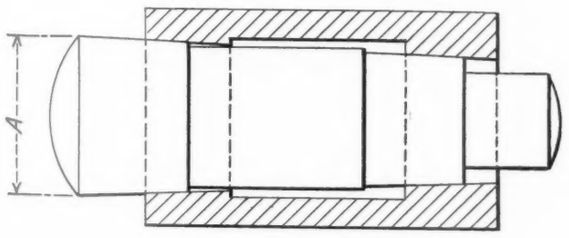


Fig. 5

moving the bushings from the rod. In this case the lever, rod or part may be clamped to an angle plate bolted to the table of the internal grinder and the machine adjusted so that the spindle will grind central with the hole. The hole may then be ground to one of the step sized plug gages. This will finish the hole cylindrically and of one size for its entire length and produce a good bearing on the pin. When holes are only slightly worn it is difficult to ream or lap them and produce a round hole of equal diameter from end to end. With hardened surfaces the only other method would be lapping with lead lap, which is not entirely satisfactory for the various bearings used on locomotive motion parts.

Third.—Bushings badly worn so that renewals are necessary: In this case, after removing the bushing, it is well to examine the hole from which it is removed and if it is found tapered or out of round it may be ground on the internal grinder to insure the next bushing fitting properly. This may seem to be an extra operation. However, this practice will eventually result in an improvement in the levers and in the security of the bushings. When grinding these holes it is well to grind to a plug gage for convenience in determining the proper size for the bushing to be applied. With the holes in the levers ground to one of the plug gages, the outside of the bushing to be applied may be ground on the cylindrical grinder a certain amount larger to allow for force fit, similar to the practice with new bushings applied to new standard parts.

When forcing bushings in place the hole will be compressed a certain amount, depending on the thickness of the walls and other causes. This will have the effect of reducing the diameter of the hole in the bushing. For the average repair work the hole in the bushing should be ground after applying to insure proper size and good bearing surfaces.

It is entirely within the range of possibilities, especially for new work, to grind the holes in the bushing previous to applying them, a slight amount large to allow for this compression. This practice would make it possible to grind the holes in these bushings in quantities, which would be

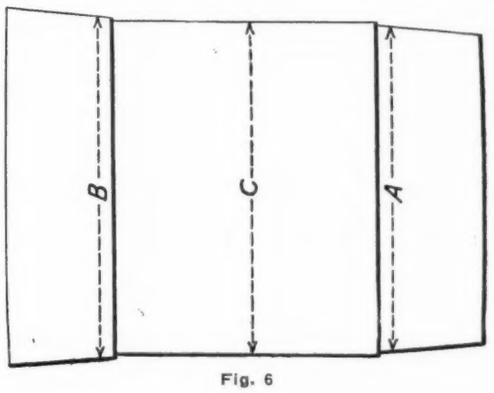


Fig. 6

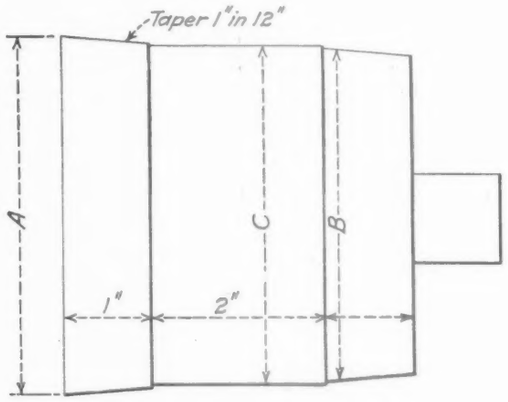
cheaper than finishing them singly. If the practice of finishing holes into which the bushings are to be applied to plug gages and grinding the outside of the bushing is followed, there would be no difficulty in arriving at the proper amount to allow for compression of the hole in the bushing. Generally speaking, the outside of the bushing should be from .0015 to .002 larger for each one inch in diameter than the hole. The holes in the bushings will compress about one-half that amount. This, however, will vary with different thicknesses of bushings. If the conditions were as mentioned, the outside diameter of a nominal 2-in. bushing would be 2.004 in. and the hole if required to be 1¾ in. should be finished .002 in. large, or 1.750 plus .002, equalling 1.752 in.

Fourth.—New bushings used in connection with pins having taper ends as shown in Fig. 6: When applied to repair work these bushings can in the majority of cases have standard sized holes, similar to those required for new work. When the taper holes in the companion lever have been worn or reamed a large amount, it will be necessary to go to a larger sized hole in the bushing on account of the taper hole in the smaller hole jaws equalling the size of the standard straight body of the pin.

With reference to Fig. 6:—The largest part of the taper *A* can only be equal to the body *C* and obtain a full bearing for the smaller taper end of the pin. When the taper *A* exceeds the dimension of *C* it is advisable to make the bush-

ings and body of pin *C* considerably larger. This may be increased by certain increments as may be decided on. That is, assuming that dimension *C* when standard is two inches, the next increase for bushings may be to 2.100 in. and the next to 2.200 in. The size of these steps will be largely governed by the degree of taper and space available for the bushing. Generally, where tapers are one inch per foot, steps of .100 in. will be found satisfactory. This point can readily be determined by calculation or laying out the work on the drawing board. By adopting some standards of step sizes, or as they may also be called, over sizes for repair work, it will be possible to make these over sized bushings in large quantities, bored to approximately the correct size. Where hardened bushings are used they may be kept in stock all hardened. When applying them it will only be necessary to turn or grind the outside of bushings to fit the hole in part where it is to be applied and to finish the hole. Or to put it somewhat clearer, when the taper *A* is smaller than body *C*, standard bushings and pins can be used. Where the taper in lever has been reamed a very large amount one of the step sizes above standard should be used. This would apply where both the bushing and pin are renewed. If the pin is only slightly worn on the body *C* and is otherwise good, it may be found more economical to regrind the pin and select or make a bushing to fit it, on account of the pin being the more expensive. For this purpose the small step sizes, such as .010 will be found very convenient if kept in stock in small quantities.

Fig. 7 shows suggested sizes for side rod knuckle pins

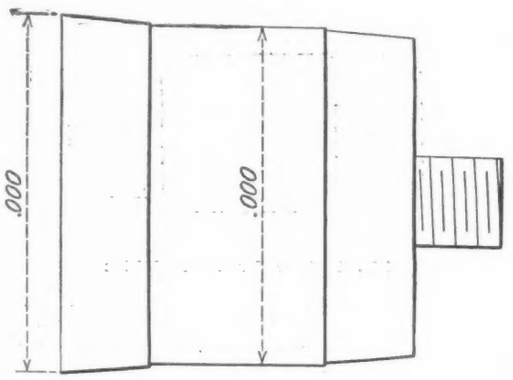


A	B	C
4.080 in.	3.830 in.	3.992 in.
4.090 in.	3.840 in.	3.992 in.
4.100 in.	3.850 in.	3.992 in.
4.110 in.	3.860 in.	3.992 in.
4.120 in.	3.870 in.	3.992 in.
4.130 in.	3.880 in.	3.992 in.
4.140 in.	3.890 in.	3.992 in.
4.150 in.	3.900 in.	3.992 in.
4.160 in.	3.910 in.	3.992 in.
4.170 in.	3.920 in.	4.092 in.
4.180 in.	3.930 in.	4.092 in.
4.190 in.	3.940 in.	4.092 in.
4.200 in.	3.950 in.	4.092 in.

Fig. 7—Suggested Sizes for Side Rod Knuckle Pins

having taper of one inch per foot, which general scheme will also answer for any similar design of pin. As shown, the large end of pin *A* would agree in size with the taper plug gage in Figs. 2 and 3. The dimension *C* should be a trifle smaller than the plug gage for companion bushings, to allow for lost motion, and is here shown 3.992 in. or .008 in. smaller than four inches, which would be the size of the plug gage for the bushing. The dimension *B* will agree with the taper if made continuous from end to end and need not in practice be measured. It is given in the table for the purpose of showing when it is as large as *C* which then makes it necessary to go to a larger step size. In order to avoid odd decimals, the largest diameter of pin at *A* is shown 4.080 in., which is approximately correct for the dimension *C*. The step sizes of the taper are shown advancing by .010 in. and on the tenth size the straight part of pin *C* is increased .100 in. or to 4.092 in. and would be correct to fit bushing ground or finished 4.100 in. diameter.

From a manufacturing and repair point of view this method of sizes has several advantages. In manufacture the pins may be roughed out in quantities with the straight part *C* a slight amount above size to allow for final grinding and only in certain sizes, or as here shown 3.992 in., and 4.092



Engine Number———————
Pin Number———————

Allowances for running fits on pins from 1 in. to 3 in. in diameter are to range from .002 in. to .003 in. For knuckle pins from .007 in. to .010 in. For crosshead pins from .012 in. to .016 in.

Fig. 8—Suggested Form for Showing Pin Size Requirements

in. On account of the varying sizes of taper ends that would be required to meet conditions of worn and re-reamed rods it is a question if all the sizes as shown in the table should be kept in stock. Preferably the pins should be made with the largest taper for each straight size *C*. That is, according to this table pins could be made with *C* measuring 3.992 in. and 4.092 in. and the largest end 4.080 in. and 4.180 in. When finishing the pins they can be ground or turned to fit the female gage as far as the taper is concerned and measured at the large end *A* for diameter. Where the taper is finished in this manner the pin should fit the tapers in the rod perfectly. Where casehardened pins are used they may be all roughed out to sizes mentioned, the necessary keyways cut and holes drilled and casehardened in batches and put in stock until required. By roughing out the straight part *C* approximately .010 in. large, there would be no danger of finishing below the hard surface where the pins are well pack casehardened. There would be no objection to going below the casehardened surface on the taper ends, as would be necessary to obtain the varying sizes required.

Where grinding machines have not been installed these pins may be made up as mentioned above and carbonized only; that is, put through the casehardening process, but instead of quenching, allow the pins to cool slowly, preferably in the casehardening boxes. The surfaces can then be turned the same as soft tool steel and fitted to gages, as mentioned above. After the pins are to correct size they may be heated and quenched to harden the surface the same as when hardening tool steel. Where hardened bushings are used they may also be made in quantities and with the hole reamed or bored enough small to allow for final finish. The outside may be roughed out large enough to meet requirements for average conditions of rod holes. These may then be casehardened or carburized in batches and the outside ground or turned to the required size to fit the rods or the place where

they are to be applied and finally hardened by the regular methods followed with tool steel.

CONCLUSIONS

The methods of performing the various operations and measuring as has been explained are somewhat of a departure from the regular railway practices and may at first appear difficult to put in practice. It would in many shops require a number of gages, micrometers, etc., as well as calculations and study to arrive at the proper methods and step sizes to meet local conditions and designs. This article has only attempted to deal with the question in a general way.

The general effect of introducing micrometers and solid plug gages will be that the work will be finished closer to the required size largely from the fact that the workman will know how much a piece is large or small. This is difficult with other calipers except for the most experienced workmen. As a result of accurate measuring the habit of close sizes will become general and make it possible to finish parts separately with the assurance that they will fit properly when assembled, or to consider any two parts that are to go together, say a side rod knuckle pin and the rod bushing. The bushing may be finished to a solid plug gage or micrometer exactly four inches and when measured by this method would be known to be correct. The pin fitting with this bushing can then be finished say .008 small or 3.992 inches. There will be absolutely no necessity of trying two parts together. This in many cases will eliminate carting the rod to the machine when the pin is finished and possibly making several trials for size as is at times the practice where close measurements are not the practice.

The above deals with straight surfaces. The taper portions of various pins, piston rod ends, etc., may also be made interchangeable or to cover size to fit where wear has taken place by the use of gages shown in Fig. 4. Also the place where the pins are to go may be reamed and gaged by the taper plug gages, Figs. 2 and 3. The taper size of the pins, as has been explained, may in most cases be measured by micrometer calipers by taking readings over the largest part of the taper. With the size required for the largest end of the taper definitely measured and also the straight hole into which the pin fits likewise measured, blanks may be filled out giving the necessary data for the finish of the pin, a suggested form being shown in Fig. 8, on which the sizes can be filled in. Also data as to the amount of allowance necessary for flow of oil or lost motion may also be given. This will have the effect of reducing these dimensions to exact amounts and establishing a uniform practice. With this information the grinder operator can readily grind the pins to the required size both on the straight and taper surfaces, and with the assurance that they will fit.

The eventual results of adopting methods as has been explained will be that the companion parts can be made independent of each other and avoid a large amount of carting of heavy parts about the shop. This, however, is only secondary to the fact that by adopting a system as has generally been explained, the parts will fit properly and will result in saving when erecting and also improve the wearing qualities. Or looking at this question from a manufacturing concern's standpoint, the time saved when assembling the new or repaired locomotive on account of all parts fitting properly will more than pay for all gages and appliances that may be required.

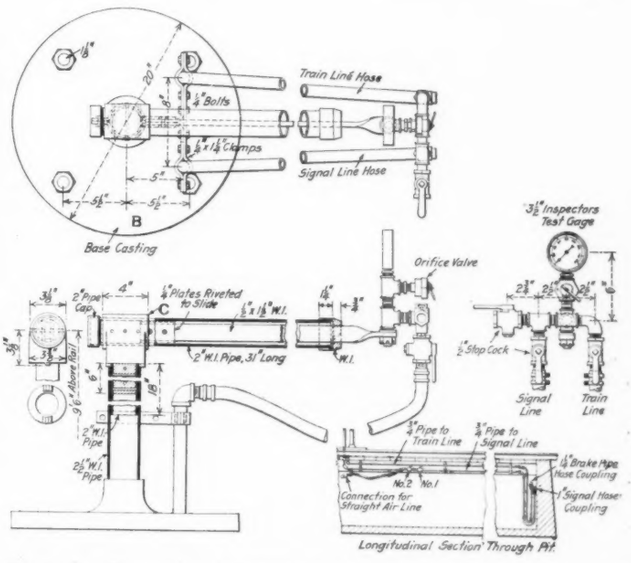
Costs.—The methods, as have been explained, will involve some costs for appliances and machines and considerable study in arriving at the proper allowances for step sizes, lost motion, drive fits, etc., for the various locomotive parts. On the other hand it will be possible to manufacture in quantities the various locomotive parts to a semi-finished state and allow the proper amount for final finishing to the required size to fit the worn and re-reamed places where they are to be applied. This will have the effect of reducing the total cost of making articles and also the amount of delays waiting on parts. Or in other words the parts may be made up in large quantities. One of the principal savings will result from the fact that parts will fit properly and avoid delays in assembling the locomotive and delays on the road.

LOCOMOTIVE AIR BRAKE TESTER

BY E. A. M.

In the drawing will be found the essential details of construction of an air brake testing device for use at locomotive inspection pits, which makes possible the completion of the necessary brake equipment tests on arrival at the terminal in about 12 minutes.

Essentially, the device is a crane for supporting the inspector's test gage and orifice valve with suitable connections to the signal and train lines, at a height such that it may be swung into the cab at the gangway, with the equipment within convenient reach of the inspector conducting the tests. The test equipment is supported at the end of a telescopic horizontal arm, which may be closed and swung out of the way parallel to the track when not in use. The test equipment is coupled up to the train and signal lines at the rear end of the tender by means of hose and standard coupling, from which pipe lines lead along the side of the inspection pit and up through the base of the crane. From the upper end of these pipes hose connections of sufficient



Crane for Supporting Locomotive Air Brake Tests Apparatus at Inspection Pits

length to provide freedom of movement for the swinging and extension of the arm, lead up to the end of the arm. To provide for locomotives equipped with combined automatic and straight air brakes, a special hose connection is tapped into the signal line in the inspection pit. When not in use this connection is closed by plug cock No. 2, as shown in the longitudinal section through the pit, and when in use the connection to the locomotive signal line is closed off by means of cock No. 1.

The upright member of the crane is a piece of 2½-in. wrought iron pipe supported in a cast iron base 20 in. in diameter, which is bolted to a suitable foundation beside the pit and so located that it stands directly opposite the

gangway when the locomotive is spotted over the pit. Resting on the top of the 2½-in. pipe is a special tee forging, to a downward projection from which is attached by means of taper pins, an 18-in. length of 2-in. wrought iron pipe. This fits inside the larger pipe and supports the horizontal arm. Where the forging rests on top of the 2½-in. pipe it is provided with lugs which fit into corresponding notches in the top of the pipe, to hold the horizontal arm parallel to the track when the device is not in use.

The horizontal arm is a piece of 2-in. wrought iron pipe, one end of which extends through a hole drilled in the special forging, to which it is attached by three taper pins. The pipe is about 30 in. long. The telescopic member is a piece of ½-in. by 1½-in. wrought iron, which slides through a special wrought iron cap on the swinging end of the horizontal arm. To the inner end of this piece are riveted two pieces of ¼-in. plate cut to fit the inside of the pipe, to keep the sliding arm in proper alinement.

To the outer end of the sliding arm is attached the test equipment. This consists of an inspector's test gage, in the line immediately below which is a tee to receive the orifice valve. Below the orifice valve is another tee, in the lower end of which is screwed a special stud by which the whole equipment is attached to the sliding arm. The connection to the signal and train lines enters the horizontal flange of this tee. Three ½-in. stop cocks complete the equipment, one each in the signal line and train line and one to provide for blowing out the whole apparatus.

After connecting the pipe lines in the pit to the signal and train lines at the rear end of the tender, the necessary tests may all be conducted by one man in the cab. Where locomotives pass over the inspection pit headed in both directions two of these devices are needed, placed on opposite sides and near opposite ends of the inspection pit.

SOFT GRINDING WHEELS*

BY HOWARD W. DUNBAR

Normally, in most grinding departments, the tendency both on the part of the grinding machine operator and his foreman is to use harder and harder wheels. The reason for this seems to usually come from the feeling on their part that because the wheel lasts longer it is naturally a more economical wheel to use. This is unquestionably a mistaken idea. Wheels are only an economical proposition when they do wear out. Now do not draw a wrong conclusion from this statement, because there is a wide difference between wheels wearing out and producing a large number of parts and those that wear out with a small production.

Soft wheels are only relatively soft. So to assume because a wheel is on a low scale in the grade list that it is a soft wheel is incorrect reasoning because it can only be soft to the grinding engineer's mind when it is free enough to cut rapidly, and in order to perform in this manner it must be soft. The grade list is merely a means for identifying certain kinds and types of wheels so that they may be readily reproduced.

The degree of softness or hardness of the wheel is best determined by its cutting action, its productibility and performance rather than by the position it occupies in any particular grade list. To go a bit beyond the usual understanding of a soft wheel, one must take into consideration the type of machine that the wheel is to be used with, the kind of material that such a wheel is to grind, the mechanical dimensions of the wheel itself as related to the dimensions of the work it is to grind. To illustrate: A wheel of a given diameter and width of face performing a grinding operation upon a piece of hardened tool steel 2 in. in diameter acts in grade (which means its degree of softness or hardness), quite differently than it would were it grinding upon a piece of the same steel 4 in. in diameter. This, to the grinding machine engineer, is logical reasoning because in the two cases cited the arc of contact is different, and the arc of contact, width of face of the wheel and radial depth of cut are factors which cause a wheel to act either hard or soft.

I have often had occasion in talking with some operator in a grinding department who felt that he was more or less in trouble because his wheel was wearing out rapidly or glazing and filling and he could not produce the large number of pieces per day that he had hoped, to receive in reply to my question, "Have you used a soft wheel?" the answer, "Oh, yes, this wheel is a *K* wheel." In his mind that wheel was soft because it occupied the position in the low scale of the grading list. He had given little thought to the fact that he was grinding work eight, ten or twelve inches in diameter. In each case the *K* wheel might have been quite a bit too hard for the operation and again undoubtedly he had paid little attention to the fact that his speeds of work revolution could be of so great assistance to him in causing that wheel to act in a proper manner.

When considering wheel grades to determine the correct one to use, the following points should be kept in mind:

1.—That the grade letter has little meaning in so far as the wheel action is concerned, it only serving as the means of identifying that particular wheel.

2.—The diameter of the work will vary the cutting action of the wheel. The smaller the work the harder the wheel may be and the larger the work the softer it must be, of course, assuming that the diameter of the wheel is the same.

3.—The larger the diameter of the wheel the harder the wheel will act. The smaller the diameter of the wheel the softer it will act, the diameter of work remaining the same in both cases.

4.—The wider the face of the wheel in contact with the work being ground, the softer the wheel must be to grind rapidly.

5.—Work speeds are provided for the purpose of varying the cutting action of the wheel; in other words, so that the wheel may be made to act soft or hard.

6.—The grain size affects the apparent grade of the wheel, finer grains appearing hard while coarse grains appear soft in their action, regardless of the bonding grade.

After all, even though the tendency be in the direction of hard wheels today, and when we say hard wheels we mean harder than necessary to perform a given operation, the day will come when operators will realize that the life of the wheel is a secondary consideration, that the number of pieces ground is of prime importance and there can be no question as to the productibility of soft acting wheels as compared with one that is hard, requiring frequent dressing to keep its face open enough to grind rapidly. It probably is a fact that 75 per cent of the defects in grinding operations can be charged to the use of too hard a wheel. Chatter marks are produced by a hard wheel. Hard wheels generate more heat in the grinding operation which changes the shape of the pieces being ground and makes more difficult the possibility of round work. Hard wheels fill and glaze, causing blemishes in the finish. Hard wheels won't "bite," as the grinding machine operator would say; that is, they do not cut freely. Hard wheels require infinitely more power, at the same time accomplishing less work. Hard wheels cause abuse to the machines, principally the spindle bearings. Hard wheels are the bugaboo of every grinding department.

*Taken from Grits and Grinds.

Railway Cars of Reinforced Concrete.—The London Times reports that experiments are being made at the plant of the Ebbw Vale Steel Company in the construction of railway cars of reinforced concrete. Experiments are being made in the United States along similar lines but as yet nothing of a definite nature has materialized.

TED SYMINGTON—NO SLACKER

BY A. J. T. CATE

As the one o'clock whistle stopped blowing, Ted Symington, the general foreman at Mt. Clary, turned on his heel and started for his office. "The end of a perfect day for mine," he said bitterly, as he recalled that he was to have been on his way to Jackson City an hour ago, where he was to meet the only girl that had ever meant anything to him, and together they were to have been the guests of friends 20 miles away in the country over Sunday.

Ted had counted on this trip for weeks. He had never had an hour off duty since coming to Mt. Clary and now, after all his longing for this Saturday to come, here he was, not only prevented from keeping his appointment, but the cause of it all meant serious trouble as well. "There'll be some explaining to do over this mess," he muttered, as he strode into his office, "what the outcome will be is more than I know." Hastily throwing off his coat and hat preparatory to washing up, he started to roll up his sleeves when he caught a glimpse of himself in the glass over the washbowl, and the sight made him pause a moment and contemplate his condition.

Long noted for his clean and orderly personal appearance, he wondered what the folks back in Danby would say if they could see him now. His face and hands were covered with grease and grime, his collar and tie were spattered with oil while his suit was practically ruined. As he gazed into the glass and behold himself in a condition that three months ago would have seemed impossible to him, he reflected bitterly on the turn events had taken since his appointment as general foreman at Mt. Clary, and he could not help wondering how much longer things could continue as they had been before he would be notified a change was to be made.

To say that things were breaking badly for Ted was putting it mildly.

Nothing went right. The harder he worked, the more hours he put in on the job, the worse matters grew. It seemed impossible to get engines out on time any more, and as for engine failures, Ted shuddered as he thought of the last bulletin he had received that morning, showing five failures for the previous 24-hour period, all of them on Mt. Clary engines and of course up to him to explain. And this reminded him again of his present dilemma this noon which had prevented him from taking his trip.

A Mallet had been run over a derailer on the outgoing lead, a couple of rails had been broken, the driver brake rigging torn off and this had to be removed before engine could be rerailed. The fire cleaner who was responsible for the accident had no authority to handle engines, all of which was bad enough in itself, but what was infinitely worse, the derailment blocked in No. 9's engine at the sand house where the hostler had taken the engine just prior to the accident, and there she was, until the lead was cleared and serviceable.

No. 9 was the limited. Anything causing a delay to that train meant trouble, and on this particular day there was no other engine at Mt. Clary capable of handling No. 9. The entire force pitched in and worked like beavers for Ted, but in spite of their efforts No. 9 left the depot 30 minutes late on account of waiting for an engine.

Ted knew there would be more trouble over this affair than any other that had occurred since his advent as general foreman. In the first place, he had been taken to task several times about men handling engines without authority, and the last time when a couple of engines had been smashed up, the superintendent of motive power had written to the master mechanic in a decidedly caustic manner, and that official passed it on to Ted with a note that made his blood boil when he read it.

As Ted vividly recalled that letter now, the worst of many bad ones he had received since coming to Mt. Clary, and remembering the many recent occurrences for which he had been criticised, it began to dawn on him that after all perhaps he was the wrong man for the job. As this thought took possession of him he hastily crossed the room and closed the door. The consciousness that he had failed overwhelmed him and he wanted to be alone now the better to think about the situation.

He knew of course that matters could not be tolerated long as they were going, but somehow he had felt big enough to pull himself out of the hole. Every game had its "bad innings" he had reasoned, and when he had succeeded in overcoming the feeling that he knew had existed against him from the first, he believed he could make a creditable showing. But now, as he surveyed the situation from a new angle he made up his mind that it was too late. He admitted for the first time to himself that he was powerless to bring about an improvement.

And what made it more bitter for him was the knowledge that he, more than all others, was to blame for his own unfortunate position. His mind went back to the time when he had graduated from college and entered the service as a special apprentice at Danby, the headquarters on the next division east of Mt. Clary.

The master mechanic at Danby, Mr. Allen, had liked Ted from the day he went to work there. While in college he had developed considerable skill as a draftsman, and when this became known to Mr. Allen, Ted got all the jobs of making sketches, drawings and blue prints needed at Danby. The result was that far too large a part of the time which should have been spent in the shop was put in at the drawing board in the apprentice school.

It must be admitted that Ted sometimes uneasily asked himself whether he might not be making a mistake. But the good hearted master mechanic made it very easy for him to neglect the shop experience he needed, for the cleaner jobs and pleasanter surroundings in the office.

Ted did not like working in the wheel gang; he had a secret feeling of contempt for a system that made a man with his education work three months with a bunch of "boneheads," as he called them, wrestling tires off and on, and the other rough work they were called upon to do. And there was the driving box and shoe and wedge jobs, and other classes of work of a similar nature. With his wide reading on these various subjects he did not consider it at all necessary to put in so much time in each gang, when he already knew the fundamental principles of it all. As for roundhouse work, the roundhouse men he knew were always plastered from head to foot with grease since the company had stopped the practice of wiping the engines, and, frankly, roundhouses did not appeal to him at all.

As time went on the general foreman and his staff at Danby, realizing how Ted felt about doing work of this kind and knowing how he stood with the master mechanic, ceased to comment as to his future mechanical ability, and Ted finally passed out of his apprenticeship without a good working knowledge of many things which he now realized he sorely needed. He was scarcely out of his time before he was called upon to relieve the night roundhouse foreman, who was off on account of sickness. The job was not a strenuous one for a foreman at any time, as the majority of the men were "old timers" and knew every move that ought to be made, so Ted had easy going, and the belief that he was a "comer" was greatly strengthened in the mind of the master mechanic. Mr. Allen never let an opportunity slip by of telling the superintendent of motive power about him, and impressing on that officer's mind that in Ted there was all the essential qualifications for a future master mechanic.

From that time on Ted was frequently used as a relieving foreman, and it was only natural for him to feel that after

all, he was capable of handling about any opportunity that might present itself in the line of supervision. As might be expected, when the general foreman at Mt. Clary resigned to accept a position as master mechanic with another company, Ted was immediately selected for the place by the superintendent of motive power, who gave the master mechanic at Walton, to whom Ted reported, a very flattering account of the new general foreman's accomplishments.

Mt. Clary, however, was a different proposition from Danby. It was the junction point of three divisions and lay at the foot of a 12-mile grade over which all freight trains westbound required from one to three helpers. There was no back shop at Mt. Clary to draw on when short of help, or to do extra machine work when up against it in the roundhouse. Moreover, what machines there were had been sent there from various shops along the road, and represented in the aggregate "a bunch of junk," as one old time mechanic put it, in complaining to Ted one day about what was expected of them, and the facilities they had to do it with. The main shop on that division was at Walton more than a hundred miles from Mt. Clary, and it often required great resourcefulness to keep power going until it could be taken there for heavy work. It required a diplomat, too, to deal with the engine crews on three divisions, and the various division officers, each intent on getting the most out of Mt. Clary. In short, that terminal had the reputation of being a "windy corner" for a general foreman, and the man who succeeded there was regarded as competent for about anything in the line of supervision.

Unfortunately the master mechanic at Walton, who was a mechanic of the old school, and who believed that a foreman to be successful should have a thorough training in all departments, had heard of Ted's apprenticeship days, and how he had "got by" at Danby. With this knowledge beforehand it did not take him long to detect Ted's shortcomings in practical experience, and he was not slow in letting him know it. Finally, the general foreman who had preceded him was a man liked by all. A thorough mechanic, skilled in handling men and in making quick decisions that were acceptable to everyone, he had been able to get results under very difficult circumstances. He had kept engine failures down better than any one else had ever done there.

Ted had got in bad almost immediately after arriving at Mt. Clary. Unaccustomed to dealing with the complex problems that were constantly put up to him, he made enemies at the start. He nearly came to blows with a road foreman over some work reported and not done, and this injured him more than anything else that could have happened, for that official never let a chance go by after that to inform the master mechanic at Walton about Ted's weaknesses. The men soon found out that he was deficient in practical mechanical knowledge and they resented having such a man put in authority over them.

And so matters had gone wrong from the start. Engine failures began to increase, terminal delays were constantly taking place, and Ted was called upon for explanations almost every hour in the day.

With his back to the wall he was fighting bravely. During the past month he had been on the job night and day, and yet results were no better, and now, as he leaned back in his chair, he read the handwriting on the wall. As he got up to reach for his coat, for he had not yet been to lunch, he caught sight of a bundle of letters hitherto unnoticed lying on his desk. Down in the middle of the package was a long, white envelope that he felt instinctively enclosed a letter from the master mechanic.

Reaching over, he pulled it part way out and noticed the word "Personal" underlined, while in the upper left hand corner his suspicion was confirmed by seeing the master mechanic's address. Ted had learned to dread those "personals," and as he held this one in his hand deliberating whether or not he would read it before going to lunch, he noticed for the first time the display type in a newspaper that had been carelessly thrown on the desk, these words:

YOUR COUNTRY NEEDS YOU

IF YOU ARE HOLDING DOWN A JOB THAT EXEMPTS YOU FROM MILITARY SERVICE WHEN YOU KNOW ANOTHER CAN FILL YOUR PLACE—YOU ARE A SLACKER.

With his gaze riveted on that second line, Ted read it again. "WHEN YOU KNOW ANOTHER CAN FILL YOUR PLACE —YOU ARE A SLACKER," he read. His hold on the long, white envelope loosened, a new light shown in his eyes —"That's me," he muttered, reaching for his coat with one hand while he shoved the paper into his pocket with the other. "You won't have to remind me of it again, Uncle Sam," he said, as he started for the door, leaving the long, white envelope unopened on the desk behind him.

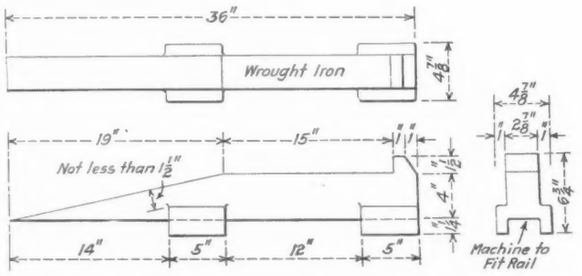
The next day while Mt. Clary was talking about Ted's sudden enlistment and his probable successor, over in Jackson City a girl received a letter which she had read many times: "I hope you will forgive me for failing to keep my appointment, but I had bad luck at the last moment, and then I had to go to the recruiting office, and they got my measure down there—well, it was all off."

WEDGE BLOCK FOR JACKING LOCOMOTIVES

BY JAMES GRANT

The wedge block shown in the illustration will be found useful in engine houses, as they eliminate to a great extent the use of jacks for locomotive work. The use of jacks for raising locomotives, particularly the heavy types now in use, is a hazardous piece of work, especially when it is considered that few engine houses have a solid floor to work from. A set of four of these wedges will be found convenient for spring and spring rigging work, engine truck and trailer work, and changing driving tires. Tire changing used to be looked upon as a job for the backshop, but since the federal laws regarding tire wear have been in operation a month seldom passes in the larger roundhouses without changing one or more sets.

For the large Mallet engines the wedges are particularly adaptable. For instance, if the high pressure engine tires



Wedge Blocks Used In the Place of Jacks for Raising Locomotives

have to be changed, run the last pair of drivers of the low pressure engine and the trailer wheels on four of these wedges, at the same time taking care to block the boxes and springs in order to retain all the slack, and lots of space will be found to slip off the old tires and put on the new ones. An engine truck can be run out easily by putting the first pair of drivers on the wedges, taking care to block solid between both of the driving boxes and the frames before moving the engine; also put blocking between the truck boxes and binders so as to keep the center casting in the same position when the weight has been removed.

The wedges, if properly made will hold the rail and the

lugs on the sides prevent any danger from tipping while the heel on top acts as a sure stop when the engine has been pulled up as far as necessary. A wedge can be forged from an old axle or any piece of scrap, and it is considered best to forge the lugs solid. After forging, the inside of the lugs and bottom of the wedge should be machined, so as to make a good fit over the ball of the rail.

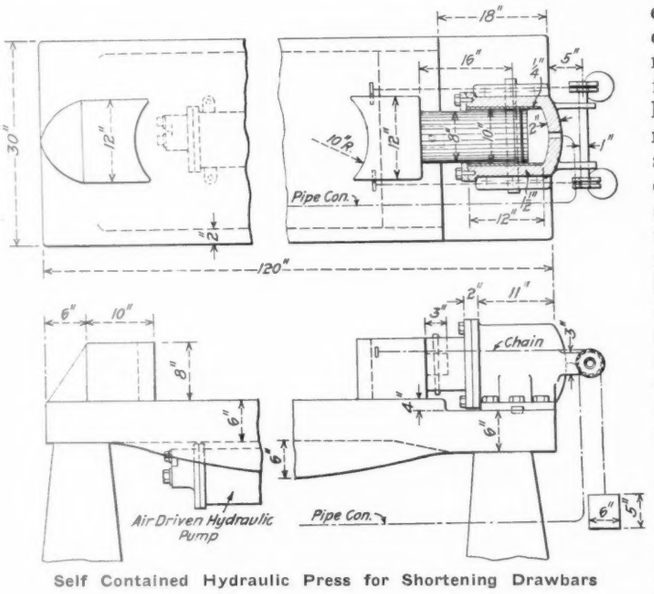
The sketch shows the wedge 36 in. long, but this can be varied according to the type of engines handled. The longer the taper the more easy can the engine be run up on to the wedge. The height over the top of the heel might also have to be changed; this depends on how much clearance the brake hangers have from the rail.

It can be readily seen that by possessing a few of these inexpensive wedges considerable time can be saved, as the above methods are far quicker than using jacks. When an engine is on the wedges it is there to stay. When using jacks it is always necessary to block up with heavy timbers.

HYDRAULIC PRESS FOR SHORTENING DRAWBARS

BY E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

A self-contained hydraulic press of simple construction has been developed and is in use at the Clifton Forge shops of the Chesapeake & Ohio for such work as upsetting locomotive drawbars and frame binders. The various operating parts of the complete machine are assembled on a table made up of a heavy cast iron top, of which the stationary resistance post is an integral part. The cylinder is designed for a 10-in. ram and is bolted and keyed to the one end of the table. A ¼-in. packing leather is secured to the end of the ram with a ¾-in. follower plate and one inch ahead of the leather the ram is reduced to eight inches in diameter.



Self Contained Hydraulic Press for Shortening Drawbars

The outer end of the ram is keyed to the movable block, which is a heavy iron casting, sliding directly upon the surface of the table. The ram is counterweighted and suitable brackets for the counterweight pulleys are cast integral with the pressure head of the cylinder.

The press is operated by a pump built from a Westinghouse 8-in. air pump, the air cylinder of which has been replaced by a specially designed cylinder having a working diameter of 1½ in. The pump is operated by compressed air from the shop line.

FULL DAY'S WORK FOR A FULL DAY'S PAY*

BY GEORGE N. DE GUIRE
General Supervisor of Equipment, United States Railroad Administration

The bill which authorized the taking over of the railroads by the Government specifically provided that we would operate them as a war measure, a war measure pure and simple, and with the taking of the railroads every officer and employee on this road ceased to have any connection whatever with it as a corporation, and you, fellow workmen, automatically became Government employees. You then began to draw your pay from the United States Government, and you became an important part of the greatest war machine the world will ever see.

When we took the railroads over, one of the first things that confronted us was a number of requests for increases in pay. You men were not asking for a nickel, but the four train service brotherhoods were in on one concerted movement. Mr. McAdoo said: "We do not want to take care of the train service employees only, we want to take care of all classes who should receive consideration, if we give to one, we will give to all who are in need of assistance." He immediately appointed a Wage Commission, and after many months of toil they recommended wage increases and such wage increases as were approved by the Director General are fair to labor in the railroad shops, on the locomotives and on the trains, and also fair to the people who are required to pay the bill. What else did Mr. McAdoo do for labor? On some of the railroads you will remember many employees had been thrown out of work and expert mechanics were denied employment by officers of these roads for various reasons. When the Government took control, Mr. McAdoo immediately issued instructions that made it possible for all of these men to resume work.

During the past four months a certain railroad discharged employees for joining a labor organization, but when such dismissal was brought to the attention of the Railroad Administration they reinstated such employees, and paid them for the time lost. On another railroad where the employees had been allowed time and one-half for Sunday work for many years, the officers decided to discontinue such allowance, but I was sent to adjust this matter and I instructed the officers that Mr. McAdoo did not approve of such reduction, so the premium overtime for Sunday work was restored. In the last six months I have handled about one hundred cases for the Government and in adjusting these matters if there has been a question of doubt I have given the benefit to those that toil. I have worked in shops, so I know your troubles, and in the months gone by I have repeatedly gone on record as favoring better conditions and increases in wages for shop crafts, and this also has been the attitude of the entire Railroad Administration, for they have followed Mr. McAdoo's policy, which is a square deal to all.

I have tried thus far in my address to show you that in the past six months Mr. McAdoo and his representatives have given a square deal to all. Now the point I want to raise is,—have you done as you ought to have done, have you reciprocated and done your part, or have you failed to do your duty, and has such failure been due to a mistake of the head, or one of the heart?

The question that brought me to this territory was to ascertain why the shop output was not measuring up to the standard it should. I find the employees are not giving the Government the output which they had given to the railroads under private control, regardless of the fact that the wages

*This is an abstract of an address to the shopmen at one of the important railway shops in the East. It was presented last August—during the war—but as it contains a message which applies to existing conditions it is printed now, having been released for publication but recently. The name of the shop at which the address was made has been eliminated by the editor as it is understood that substantially the same address was made at other shops.

have been raised and conditions improved. This is the problem that is worrying the Government: "What is the trouble?" Is it a Sinn-Feiner or an I. W. W. movement to try to prevent us from winning the war, or "are you real Americans?" Real Americans, making a mistake of the head rather than of the heart. I cannot believe you would intentionally help the Kaiser to kill our American boys. Let us stop for a moment; examine your conscience; ask yourself if you worked every day you could have worked since the war started; have you laid off and gone out for a good time, when you ought to have been at your machine turning out parts which are sorely needed; have you refused to work overtime hours; have you gone into a wash room as I saw seventeen last Saturday, reading papers and smoking, have you read newspapers during working hours; were you one of the men in the blacksmith shop who sat down and read papers in the presence of officers during working hours? Ask yourselves, "Have I given a fair day's work for a fair day's pay?"

There are some things that are going on in the shop that have got to come to a stop. I told your committee the other day that I thought the Government took over this railroad some time ago, but I found that the employees, so far as this shop was concerned, were still running it. This policy must cease, and in the future if the officers instruct you to do anything, it will be up to you to do it unless it involves bodily harm; if you think such instructions are not right, then make a grievance of the matter and handle it in the manner provided for in Order No. 8 and we will see that justice is done, but do not refuse to obey your officers, as you must obey the instructions of the officers in charge if you are to remain in Government service.

Lounging in the toilet room must cease; it is not there for that purpose. Do not use it as a play room. Another thing which must cease is the wasting of your time visiting, and the reading of newspapers while on duty in this shop. In days gone by you turned out fifty-four locomotives a month from this shop, and you are not doing it now; you did it on fifty-four hour weekly schedule, why can you not do as much in these days of trials and tribulations, as you did in time of peace? You can if you want to, and I know you will. Another question I desire to cover is starting to work promptly. When the seven o'clock whistle blows in the morning you must start work, you must be on your job and not lounge about for thirty minutes before starting to work.

We desire that all machines be kept at a speed that will insure their maximum output. I have said that insubordination must cease, men must obey orders; we want officers to be kind to the men, but we do not want them to keep men in the shops who will not help the Government. I said further to the officers, if there were men in the shop who would not work the required number of hours, that my advice would be to get rid of them; for we cannot afford to tie up machines day after day, waiting for some men who work only when they please. Men must work unless sickness prevents them from doing so. We are going to expect a sufficient amount of overtime to finish locomotives about ready to leave shop, for there is no need of holding locomotives from Saturday until Monday when, by working a few hours overtime, you can avoid it. And no man who is a real American would want to delay locomotives.

I have said to the officers, do not overdo the overtime question. Their answer was, "if the men will discontinue laying off, there will be no need of overtime." The percentage of men laying off at this locomotive shop is running as high as 20 per cent, when it should not exceed 7 per cent. We want you to work ten hours a day. We are paying the mechanics as high as $7.50 and the helpers as high as $5 for so doing and I do not care what anybody says, that is better wages than you ever got, or ever hoped to get. This is as true as we are standing here. (Applause).

Mr. McAdoo was mighty square when he dated your increases from January 1, thus giving you hundreds of thousands, yes, millions of dollars back pay; in so doing, he did something that no railroad ever did, or ever would do, and now he is requesting you to do one or two things for him. First, he desires faithful service; second, that you work all the time you can work, all the time your health and your family's health will permit. I have brought these things home to you in as plain language as I can in order to show you that you have a patriotic duty to perform. You are going to say to me, we are patriotic men. We have bought Liberty Bonds, given to the Red Cross and filled up the War Chest. I am going to reply to you by saying that it would have been much better for you to have kept all your money and given us faithful service, for what good is your money if you do not allow the Government to spend it; they would have to pay interest on it, and get no good out of it.

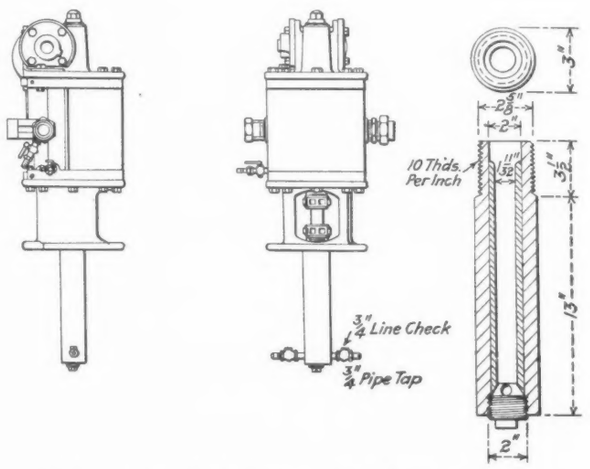
When General Pershing and his faithful boys reach home, if you have done what is right you will be able to look them in the face and say, I did not go across, but I was a real 100 per cent American Shop Soldier, and the Government told me if I was that you would come home, and you did; and then when your babies grow up and say, "Dad, what did you do in the great war?" you will be able to say, "Your dad did all the Government asked him to do, and he did his part faithfully and was a real American."

AN IMPROVISED HYDRAULIC RAM

BY CHAS. W. SCHANE

The drawing shows an interesting method of obtaining hydraulic pressure by means of a Westinghouse locomotive air compressor for testing boilers or for operating hydraulic pit jacks. A cylinder made from steel tubing with a brass liner cast in it and bored to suit the piston rod of the air compressor is screwed into the pump saddle and stuffing box gland and is secured with a lock nut.

This ram, placed in a central position with respect to the



Hydraulic Ram Made from a Westinghouse Locomotive Air Compressor

drop pits, does away with hand power for operating the jacks. The pump line is so arranged that the water will flow through the check valves to the jack and raise the plunger to the work without operating the ram. A few strokes of the ram will then do the work.

When the ram is used for testing boilers it can be mounted on a suitable cart, and when it is used for operating jacks it should be mounted on a stationary stand. This device has been in service for several months and has given good results.

NEW DEVICES

HOSE MOUNTING AND HOSE CLAMPING MACHINE

The hose mounting and clamping apparatus shown in the illustrations was developed several years ago for the use of the Westinghouse Air Brake Company, Pittsburgh, Pa., and it has proved to be an economical and satisfactory appliance. While this company has not heretofore attempted the manufacture of these devices except for its own needs, it has arranged so that they can be procured on order, either as complete outfits or merely such details as are not obtainable from existing railroad material. These can either be obtained from the company or made to blue prints which it will furnish on request.

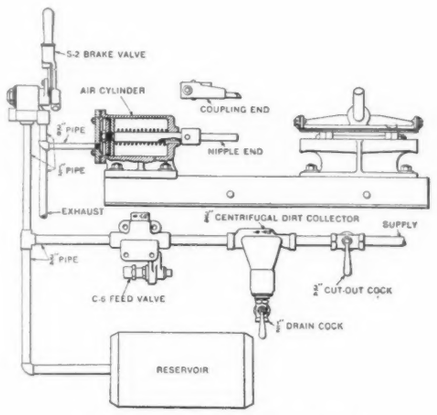


Fig. 1—Hose Mounting Machine

HOSE MOUNTING MACHINE

Referring to Fig. 1 it will be observed that the hose mounting machine consists of a Z-bar frame on which is mounted a hand operated clamp, designed to grip the hose throughout the greater part of its length so as to hold it rigid while the coupling or nipple is being applied; a compressed air cylinder; an operating valve for controlling admission and exhaust of the air from the compressed air cylinder, and accessories including a reservoir, C-6 feed valve and cocks.

The piston rod of the cylinder is adapted to the special heads used for mounting the coupling or the nipple. These heads are removable so that both the nipple and coupling can be mounted on a single machine, although not at the same time.

The operation of the machine is essentially as follows: The hose is placed in the hand operated clamp. The shank end of the nipple or coupling, before being placed on the head, is dipped in rubber cement which acts as a lubricant and also serves to make an air-tight and rigid joint. The clamp is then drawn down to hold the hose rigid; the handle of the operating valve is moved to application position admitting air to the cylinder, causing the piston and rod to move out and forcing the shank end of the nipple or the coupling into the hose. The handle of the operating valve is then moved to release position in which the air is exhausted from the cylinder and the piston and rod returned to normal position. The clamp is then released and raised, allowing the hose to be removed.

When all of the couplings have been applied to one end of the hose, the head on the cylinder piston rod is changed and the nipples applied to the other end of the hose in the same manner.

HOSE CLAMPING MACHINE

The hose clamping machine shown in Fig. 2 consists of two hardened steel jaws, one of which is movable, a compressed air cylinder, the piston rod of which is connected to the movable jaw, a tension spring attached to the lower end of the movable jaw providing for the opening of the jaws when the air pressure is released, an adjustable support to provide for the various sizes of hose used (to be lowered for the larger sizes and raised when applying the clamps to the smaller sizes. This is important, as the points of the jaws must properly engage the shoulders of the clamp to avoid pinching the hose), an operating valve and a feed valve, together with the usual reservoir and accessories such as cocks, etc.

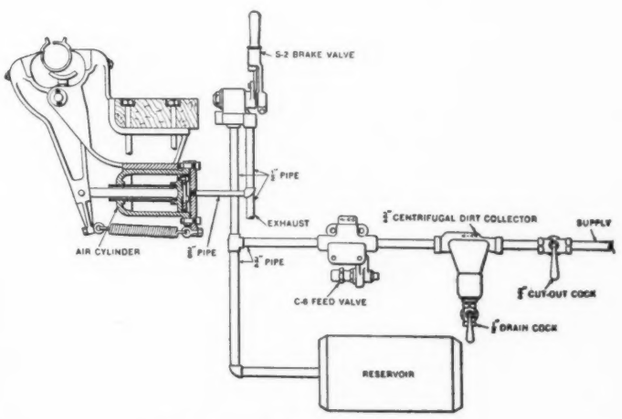


Fig. 2—Hose Clamping Machine

After the coupling and nipple have been applied, the clamps are first loosely strung on the hose. This is readily accomplished by kinking the hose to permit of slipping on the clamp through the opening between the lugs. The hose is then laid on the support and the clamp placed in position by hand. (It is important that the clamp be between the end of the hose and the bead on the shank of the coupling

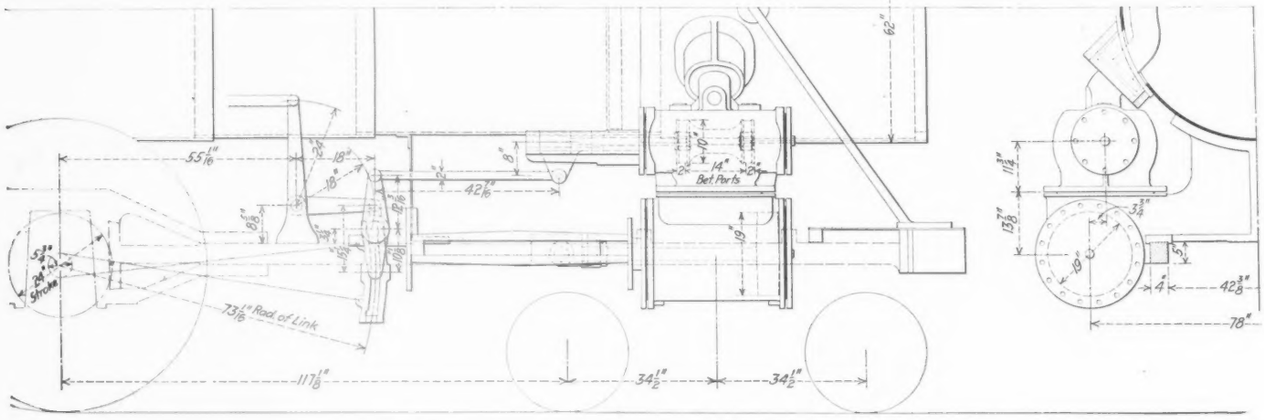
or nipple and *not on the bead.*) The operating valve handle is moved to application position admitting air to the compressed air cylinder, forcing out the piston and rod and causing the jaws to close, gripping the clamp just back of the shoulder, closing it and holding it closed while the bolt is applied and the nut run up on the bolt until it comes tightly in contact with the lug on the clamp. The pressure is then released by moving the handle of the operating valve to release position, the hose turned end for end and the same operation repeated.

The compressed air used for both mounting the fittings into the hose and for clamping is taken from the shop line and should have a pressure of between 70 lb. and 80. lb.

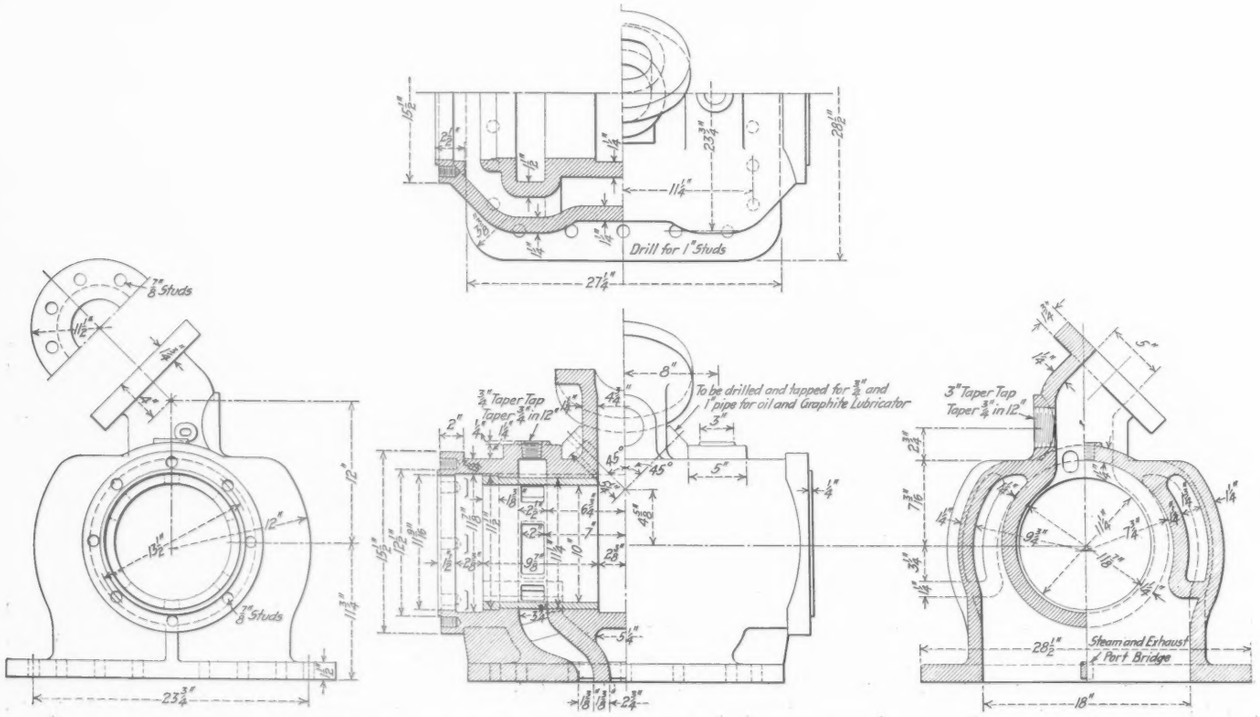
In mounting couplings and applying clamps, care must, of course, be taken to observe the proper relationship and position which is called for in the Master Car Builder's regulations.

INSIDE ADMISSION PISTON VALVE CHEST FOR SLIDE VALVE CYLINDERS

The Chicago Great Western during the past few years has applied superheaters to a large number of locomotives which formerly used saturated steam. In carrying out the program for modernizing the motive power it was found desirable to change over a class of slide valve Consolidation engines. The expense involved in applying new cylinders was so great and material so difficult to secure that it was finally decided to apply a piston valve chest on the original cylinders. A design was accordingly worked out by A. B. Clark, master mechanic, and has since been applied to a large number of engines.



Method of Applying Valve Chest to Eight-Wheel Locomotives


Drill for 1" Studs
27 1/4"
7/8" Studs
3/4" Taper Tap Taper 3/4" in 12"
To be drilled and tapped for 3/4" and 1" pipe for oil and Graphite Lubricator
3" Taper Tap Taper 3/4" in 12"
Steam and Exhaust Port Bridge
23 3/4"
18"

Details of Valve Chest Used on the Chicago-Great Western

A unique feature of the arrangement used on the Chicago Great Western is that it employs an inside admission piston valve. The steam enters the steam chest through an outside

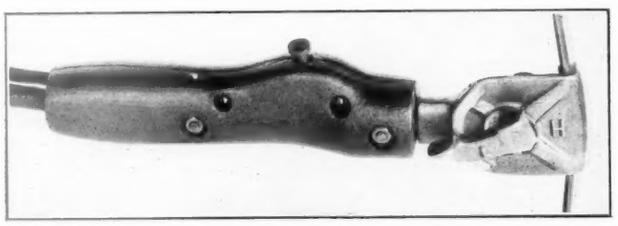
steam pipe, and a short passage leading to the center of the valve. After being admitted to the cylinder it is exhausted into the ends of the steam chest. From this point a passage leads along the side of the chest, turning downward after passing the ports and leading into the exhaust cavity at the center of the valve seat. The live steam passages in the cylinder leading from the saddle are blocked.

Excellent results were secured with this arrangement on the Consolidation locomotives. It is now planned to apply piston valve chests to a number of eight-wheel locomotives which are to be superheated. The general arrangement of the engine with piston valves is shown in the illustration. The change from an outside admission to an inside admission valve necessitates a few alterations in the valve gear. It is not feasible to bring the center line of the piston valve down to the level of the valve stem, so it is necessary to use a long crosshead to which the valve stem is attached.

When the design of this steam chest was prepared it was thought that the circuitous course the exhaust steam followed would have a tendency to increase the back pressure in the cylinders, and for that reason special care was taken to provide passages of ample cross-sectional area. Experience with the converted engines indicates that this has been successfully overcome, as there is no perceptible increase of back pressure over the locomotives of the same type fitted with slide valves. A patent on this steam chest has been granted to Mr. Clark and the manufacturing rights are controlled by the Franklin Railway Supply Company, New York.

ARC WELDING TOOL WITH POSITIVE ELECTRODE CLAMP

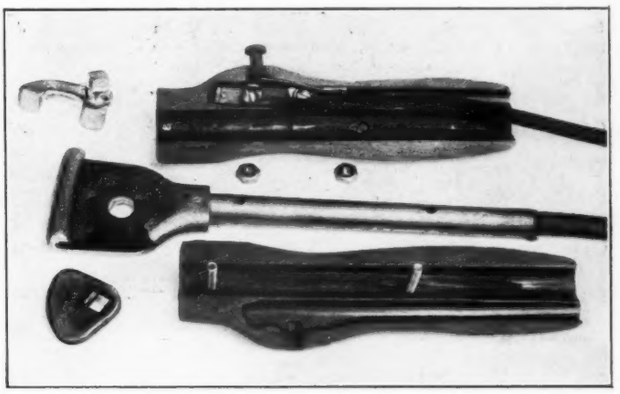
In metal electrode arc welding, a considerable portion of the operator's time is consumed in changing welding electrodes. A variety of welding tools have been developed and placed on the market. The oldest forms consisted of a pair of spring tongs which had to be spread apart by an instrument similar to an offset screwdriver when it was desired to insert the electrode and release it. Another type employed a pair of tongs which could be operated by a thumb lever. The disadvantage of this scheme was that in case the electrode stuck to the work the operator released the tool, drawing an arc between the tongs and the electrode, a practice which soon destroyed the tongs. The type in most common use employs a strong compression spring. If this spring is strong enough to hold the electrode when it freezes to the work so that the electrode cannot be pulled away from the tool, it requires considerable strength to operate it and is therefore not always suitable where girl operators are employed.



Arc Welding Tool with a Positive Clamp for Holding Metal Electrodes

After a study of these conditions the tool shown in the illustrations was developed and patented by the Arc Welding Machine Company, Inc., New York. The purpose was to make the operation of changing electrodes absolutely definite and to provide an instrument that would hold the electrode firmly in case it froze to the work, at the same time have it operate easily for voluntary release.

In this tool the welding current enters at the rear end of the composition shank, passes along the shank to the head of the tool, and from there directly into the electrode. It will be noted that there are no joints except where the cable is soldered into the shank. Therefore, heating due to contact resistances cannot occur. There is a relatively large contact surface between the electrode and the holding head, which insures against heating at this point. The electrode is clamped by a spiral segment operated by a lever. The lever is thrown to the widest open position to insert the electrode, and then is turned in the opposite direction as far as it will go. Any attempt to pull out the electrode, results in tightening the grip of the segment, which is made of case-hardened steel.

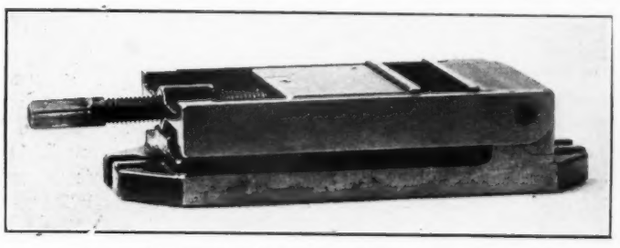


Arc Welding Tool Dissembled

The trigger is intended for remote control, employed with the closed-circuit system, manufactured by the Arc Welding Machine Company, Inc. When this holder is used on other systems the trigger is omitted.

MILLING MACHINE VISE

A quick operating vise for use on milling machine tables fitted with side bars to take the clamping strain has been developed by the Edlund Machinery Company, Inc., Cortland, N. Y. The purpose of the side bars is to prevent the stationary jaw from being forced out of square under the action of the clamping strain and also to prevent the breakage of the base when undue strain is applied. The side bars are hinged to the stationary jaw and in operating the vise they are raised to a vertical position. In raising the bars the sliding jaw is moved away from the work by a cam arrangement. After placing the work the side bars are lowered, which automatically moves the sliding jaw up to the work, the final clamping pressure being applied by tightening the screws. This type of vise is made in four sizes weighing from 23 lb. to 95 lb., with a range of jaw opening from 2 in. to 4½ in. The width of the jaws varies by steps of one inch from 4⅛ in. to 7⅛ in. The jaws are hardened and ground.



Milling Machine Vise with Side Bars

Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION
with which the AMERICAN ENGINEER *was incorporated)*

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WE GUARANTEE, that of this issue 6,950 copies were printed; that of these 6,950 copies 6,042 were mailed to regular paid subscribers, 57 were provided for counter and news company sales, 184 were mailed to advertisers, 66 were mailed to employes and correspondents, and 601 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 91,300, an average of 7,608 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)

From January 1 to October 31, 7,251 freight cars and 94 passenger cars were constructed in railroad shops.

The Russian government has recently reinstated orders for 4,000 of the freight cars it had previously ordered and later cancelled. The American Car & Foundry Company will build 2,600 and the Standard Steel Car Company 1,400.

The Committee on Car Construction of the Master Car Builders' Association has sent out Circular 19 to members, asking for suggestions for the modification of the methods outlined in Rule 22 of the interchange rules for the splicing of car sills. Recommendations are to be sent to W. F. Keisel, Jr., Pennsylvania Railroad, Altoona, Pa.

A press dispatch from Tours, France, says that during the month of October our Yankees assembled and placed in service 150 French and Belgian locomotives, 2,546 freight cars, and 1,262 American locomotives. Nearly 13,000 American freight cars were then being operated by the Service of Supply. American engineers repaired in October over 300 French locomotives and 1,000 cars.

At the suggestion of the mechanical department of the Railroad Administration, the Master Car Builders' Association has modified its Rule 3-I, which provided that after October 1, 1918, all wooden cars of less than 60,000 lb. capacity, having short draft timbers, would not be accepted in interchange. An investigation was made to determine how many cars such a rule would cut out of joint service and it was found that on the first of this month there were 58,188 such cars, of which 40,514 were box cars. The rule was modified to change the effective date to October 1, 1920.

Court Order Restrains Acceptance of Standard Cars

A temporary restraining order was issued Monday in the United States District Court, at Toledo, Ohio, against William G. McAdoo as director general of railroads, instructing the receiver of the Toledo, St. Louis & Western railroad not to accept cars, sign contracts or to do anything that would jeopardize or compromize the interests of the stockholders of the road. A hearing on the injunction was set for December 16.

The case in question is one in which the stockholders' protective committee of the Toledo, St. Louis & Western seeks to prevent Mr. McAdoo from compelling the road to accept 1,250 freight cars, which the committee asserts the road does not now need and for which the committee declares the road would have to pay an exorbitant price.

Burning Electric Locomotive Ties Up Four-Track Line

On November 20 an electric locomotive on one of the lines running out of New York caught fire a short distance outside of the city, completely tying up a four-track railroad for about two hours. The fire was caused by a breakdown in the insulation of a 640-volt lead to one of the motors, which formed a ground and set the insulation of the cables on fire. The engine crew, which had just started the fire under the heater for the car heating system, mistook the smoke of the burning insulation for the smoke from the heater, with the result that the fire from the burning insulation and the woodwork on the locomotive gained such headway before it was observed that they were unable to control it; although it is said that had the means at hand been properly used at the inception of the fire, no serious trouble would have occurred. Local fire apparatus was called and the power was shut off from the portion of the line in the vicinity of the fire. By the time the fire apparatus had arrived the fire had developed throughout the entire locomotive and had assumed such proportions that it was impossible to get at it effectively, and it was a case of leaving the fire to burn itself out. It was surprising to those witnessing the spectacle that an electric locomotive had so much combustible material in it, as these are ordinarily considered fireproof machines.

To Assist Discharged Soldiers in Obtaining Employment

Representatives of the United States Employment Service are to be stationed in all army camps and stations in this country to assist discharged soldiers in securing suitable civilian employment, according to an arrangement made effective between the War Department and the Department of Labor. Under this arrangement, agents of individual companies will not be allowed to enter the camps to recruit labor for any particular enterprise or solicit or make contracts with discharged soldiers. All employers desiring to employ discharged men should communicate at once with the federal directors for the states in which their work is located. It is also provided that the railroad and fuel administrations, the Shipping Board and the postoffice department may send accredited representatives to the camps to furnish the camp commanders with information as to opportunities for work.

Railroad Men Handle 14-inch Guns on Railway Mountings

Lieutenant-Commander D. C. Buell, of the United States Navy, well known to railroad men as director of the Railway Educational Bureau, of Omaha, Neb., has returned from an interesting expedition to France, where he had charge of the erection and putting into service of a mobile battery of 14-inch naval guns on railway mounting. This battery was in active operation on railway lines at the front and wrought considerable destruction back of the German lines. Lieutenant-Commander Buell has been connected with the Bureau of Ordnance of the Navy since last February. He was in Washington to offer his services in connection with the fuel conservation campaign when he happened to hear that a railroad man was needed to supervise the construction and later the erection of the mounting and equipment for the big guns. Within a few hours he had enrolled in the navy as a lieutenant and he was allowed four days in which to arrange his business affairs at Omaha before reporting at the Baldwin Locomotive Works at Philadelphia. He was later promoted to lieutenant commander, in recognition of his services in expediting the work; and he was sent to France with 200 railroad men, whom he selected from among the enlisted men at the Great Lakes Naval Training Station, to mount the guns, make up the trains of cars which accompany them, and organize the forces. This work was done at the locomotive erection shop by the Nineteenth Engineers (Railway).

Recent Changes in the M. C. B. and M. M. Associations

F. McManamy, assistant director of the division of operation, U. S. R. A., in charge of the mechanical department, has been made an honorary member of both the Master Car Builders' and the Master Mechanics' associations. George Laughlin, superintendent of car department, Armour Car Lines, has been appointed a member of the arbitration committee of the M. C. B. Association. J. J. Burch, district car inspector, Norfolk & Western, has been appointed chairman of the Loading Rules Committee of the M. C. B. Association, succeeding A. Kearney, resigned, and J. E. Mehan, assistant master car builder of the Chicago, Milwaukee & St. Paul, has been appointed a member of this committee, increasing the number of members to eight. The following changes in committees have been made to fill the vacancies caused by the resignation of C. D. Young, who has entered active military service: H. E. Smith, of the division of operation, inspection and tests section, has been appointed a member of the M. C. B. Committee on Specifications and Tests for Material. B. J. Burns, superintendent of rolling stock of the Michigan Central, has been made chairman of the M. C. B. Committee on Brake Shoe and Brake Beam Equipment, and F. Waring, engineer of tests, Pennsylvania railroad, has been made a member of the committee. F. Waring has been appointed chairman of the Committee on Specifications and Tests for Materials of the M. M. Association, and J. C. Ramage, superintendent of tests on the Southern Railway, has been made a member of the committee. A. R. Ayers, superintendent of motive power, New York, Chicago & St. Louis, has been made a member of the Committee on Specifications and Recommended Practice of the M. M. Association.

The revised specifications for tank cars are now ready for delivery and prices are given in Circular No. 22. Another recent circular announces an increase in the price of Pintsch gas from $1.10 to $1.45 per receiver.

Pershing Car and Locomotive Orders Held Up

A despatch from Tours, France, the headquarters of the Railway Service Expeditionary Forces, announces that 43 construction projects, including a deepwater dock for 20 ships, terminals, warehouse and railroads have been cancelled, and orders for 2,000 locomotives, 61,000 freight cars and hundreds of cranes, tugs, barges and derricks have been recalled, while orders for cars and locomotives are recalled as far as the Expeditionary Forces are concerned. Only the recent order for 40,000 freight cars divided between 17 car building companies in the United States, and orders for 1,500 locomotives placed with Baldwin have been definitely cancelled as yet, as it is hoped some arrangement can be made for the disposition of the remaining outstanding orders to the French government or the French railways.

The locomotive and car orders for the forces overseas totaled 2,510 and 70,000, respectively. In the case of the locomotives, 500 were ordered in July and the Baldwin Locomotive Works left off producing United States standard locomotives to work on "Pershing" locomotives exclusively. The order was soon supplemented by 10 more for replacements and then by 500, making a total of 1,010, of which some 750 have now been delivered. The 1,500 which are cancelled were covered in two orders placed in September. Similarly as to the cars, two orders were placed in July for 10,000 and 20,000, respectively, followed by 40,000 more in September. The latter 40,000 are the ones mentioned as cancelled.

Production of Locomotives

The standard gage steam locomotive industry of the United States, operating under the direction of the War Industries Board, increased its rate of production approximately 100 per cent in the months of August, September and October, according to a statement authorized by B. M. Baruch, chairman of the War Industries Board. During the last week of October the output of the three standard gage companies was 144 locomotives. From 1910 up to August, 1918, the largest number ever turned out in a single year was 3,776, which would represent an average weekly output of 72.6 locomotives. The statement emphasizes the fact that this increase in production has been accomplished without any expenditure to increase plant facilities or enlarge the existing works, but has been made possible by a redistribution of orders and concentration by each of the plants on particular types of locomotives. What the statement calls the "Pershing" locomotive, built on standard plans designed for the United States military railways, is said to have been made the sole type of steam locomotive in use behind the American lines in France and also to have been adopted by the British and French governments as the standard type for their armies on the western front.

Normally the output of the Baldwin works has not ex-

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Dec. 10, 1918	Car Trucks	L. Brown	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Jan. 10, 1919	Discussion of Fuel Conservation		Harry D. Vought	95 Liberty St., New York.
Cincinnati				H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Dec. 10, 1918	Fuel Conservation	Robert Collett	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Dec. 20, 1918	Work of the American Railroad Men in the War. Illustrated talk by Lt. Commander D. C. Buell on 14-in. Naval Guns Mounted on Railway Cars	Col. H. C. Booz	Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Dec. 27, 1918		M. J. Hepburn	M. J. Hepburn	102 Penn Station, Pittsburgh, Pa.
St. Louis	Dec. 13, 1918			B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Dec. 16, 1918			A. F. Stuebing	750 Transportation Bldg., Chicago.

ceeded 60 locomotives a week. During the week referred to it turned out 87 steam locomotives, seven gasoline locomotives and three electric locomotives, besides making general repairs on 10 steam locomotives. The American Locomotive Company has also accomplished excellent results, for while the number of locomotives is not so great the tonnage is proportionately as large. It is stated that the government is spending this year in the construction of locomotives for use in France and on the railroads in this country approximately $200,000,000.

MEETINGS AND CONVENTIONS

Chicago Car Foremen's Association.—At the annual meeting of the Car Foremen's Association of Chicago, held at the Morrison Hotel, Chicago, on November 11, the following officers were elected for the ensuing year: President, E. C. Chenoweth, mechanical engineer, Chicago, Rock Island & Pacific; first vice-president, M. F. Covert, Standard Car Construction Company; second vice-president, James Reed, assistant master car builder, New York Central; treasurer, F. C. Schultz, chief interchange inspector; secretary, Aaron Kline, 841 Lawlor avenue, Chicago.

Locomotive and Car Foremen Organize.—An organization which promises to be one of international scope was started in Chicago, Ill., on November 13. J. A. O'Neill, St. Louis, Mo., president of the International Association of Railway Supervising Foremen, was present and addressed the meeting. Mr. O'Neill is a mechanical engineer and had no difficulty in convincing the men in these two mechanical departments of the practicability of such an organization. A local lodge with a membership of 200 was then organized, and the officers elected. George Warlick, master painter, Chicago, Rock Island & Pacific, was elected president; Dan Hayes, foreman in the locomotive department, vice-president, and John Ebler, electrical engineer, secretary and treasurer. Meetings will be held monthly and the indications point to a large growth, as it is known that the foremen on all other lines are quite favorable to this movement. The object of the association is the promotion of harmony and good fellowship, and loyalty to their trust.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

Ernest R. Breaker, chief engineer of the San Antonio, Uvalde & Gulf, has been appointed assistant mechanical superintendent with headquarters at North Pleasanton, Tex. He was born at Fayette, Mo., on July 5, 1886, and was educated at Washington University. He began railway work in April, 1909, as assistant engineer of construction on the San Antonio, Uvalde & Gulf, in charge of bridge work. In 1911 he was made chief engineer in charge of construction and maintenance, and in 1915 he was appointed also mechanical engineer. He was given complete charge of the mechanical and maintenance departments in January last, and when the road was placed under federal control he was appointed assistant mechanical superintendent in charge of motive power and car departments, the maintenance of way department and valuation.

R. W. Burnett, shop superintendent of the Missouri, Kansas & Texas Railway of Texas, at Denison, Tex., has been appointed mechanical superintendent of the Missouri, Kansas & Texas and the other roads under the jurisdiction of J. S. Pyeatt as federal manager. His headquarters are at Denison.

Edwin G. Chenoweth, mechanical engineer in charge of car design on the Rock Island Lines, with office at Chicago, has been appointed mechanical engineer in charge of both locomotive and car design. Mr. Chenoweth was born on December 18, 1873, at Union City, Ind. He graduated from Purdue University in 1895, and entered railway service as a special apprentice with the Erie, at Huntington, Ind. After completing his apprenticeship he was employed as machinist for five years. During this time he took a post-graduate course at Purdue University and subsequently was air brake instructor and foreman of the air brake department of the Erie at Huntington. In 1901 he went to the Pennsylvania as a draftsman at Altoona, Pa., and later was employed in a similar capacity on the Pere Marquette, the Lake Shore & Michigan Southern, and the Philadelphia & Reading. He returned to the Erie in 1906 as mechanical engineer, with headquarters at Meadville, Pa., and in July, 1912, he became connected with the Rock Island Lines as assistant superintendent of the car department. One year later Mr. Chenoweth was promoted to mechanical engineer, in charge of car design, which position he held until he was recently given charge also of locomotive design.

E. G. Chenoweth

J. T. Carroll, mechanical assistant to Charles H. Markham, regional director of the Allegheny region, United States Railroad Administration, has been appointed general superintendent maintenance of equipment of the Baltimore & Ohio Eastern lines, the Coal & Coke, the Wheeling Terminal, the Western Maryland, the Cumberland Valley and the Cum-

berland & Pennsylvania, with headquarters at Baltimore, Md., succeeding F. H. Clark, resigned.

H. B. GAMER has been appointed acting electrical engineer of the Union Pacific, with headquarters at Omaha, Neb., in place of G. C. Wilson, resigned.

N. B. EMLEY has been appointed fuel supervisor of power plants and shops of the Erie, with headquarters at Meadville, Pa., and will supervise the handling and economical use of fuel at all power plants and shops on the system, reporting to A. G. Trumbull, assistant to the general mechanical superintendent.

J. O. ENOCKSON, master mechanic of the Chicago, St. Paul, Minneapolis & Omaha at Sioux City, Iowa, has been appointed superintendent of motive power and machinery with headquarters at St. Paul, Minn.

B. J. FARR, whose appointment as superintendent of the motive power and car department of the Grand Trunk Western Lines, with headquarters at Detroit, Mich., was announced in the November *Railway Mechanical Engineer*, was born at Ellenburg, N. Y., on September 8, 1876. He began railway work in 1893, as a machinist apprentice for the Central Vermont at St. Albans, Vt., and after completing an apprenticeship of five years he was made erecting shop foreman, being advanced to general foreman in 1900. In 1905 he went to the Delaware & Hudson as general foreman of the motive power and car department at Schenectady, N. Y., and the following year he became master mechanic for the United Fruit Company's lines at Port Limon, Costa Rica. From 1908 to 1914 he was employed in the engineering department of the Isthmian Canal Commission at Gatun and Cristobal. He then became connected with the Grand Trunk as general foreman on the western lines, at Battle Creek, Mich., and in 1916 was promoted to master mechanic at that point, which position he held until he received his recent appointment. He will also have jurisdiction over the Detroit & Toledo Shore Line.

GEORGE S. GOODWIN, mechanical engineer of the Rock Island Lines, has been appointed corporate engineer of equipment of the Chicago, Rock Island & Pacific, with headquarters at Chicago, having jurisdiction over matters relating to the maintenance of equipment department involving the corporation's interests. Mr. Goodwin was born at Corinth, Me., on November 29, 1876, and was graduated from Cornell University in 1899, with the degree of mechanical engineer. While attending college he spent his vacations in railway shop work and specialized in railway engineering during the last year. He entered the service of the Chicago, Milwaukee & St. Paul in June, 1899, as a special apprentice at West Milwaukee, Wis., and subsequently was employed on special test work, etc., during which time he had charge of the company's dynamometer car on other roads as well as the Chicago, Milwaukee & St. Paul. In May, 1904, he entered the mechanical engineer's office of the Great Northern at St. Paul, Minn., where he was engaged in work connected with the standardization of locomotive and car details and also the design of new equipment. Mr. Goodwin went to the Chicago, Rock Island & Pacific in January, 1906, as chief draftsman at Chicago, and in May, 1910, he was promoted to assistant mechanical engineer at Silvis, Ill. He was appointed mechanical engineer of the Rock Island Lines, in charge of locomotive design, with headquarters at Chicago, in June, 1913, which position he held at the time he was recently made corporate engineer.

George S. Goodwin

F. H. CLARK, general superintendent maintenance of equipment of the Baltimore & Ohio, with office at Baltimore, Md., has resigned.

E. L. GRIMM, mechanical valuation engineer, has been appointed mechanical engineer of the Northern Pacific, with headquarters at St. Paul, Minn., succeeding W. J. Bohan, promoted.

HARRY C. OVIATT, heretofore superintendent at Danbury, Conn., has been appointed superintendent of motive power of the New York, New Haven & Hartford, the Central New England, the New York Connecting, the Wood River Branch, the Union Freight Railroad and the Narragansett Pier Railroad, with headquarters at New Haven, Conn. Mr. Oviatt was born in Milford, Conn., on December 5, 1871, and received his education in the grammar schools. His entire railroad career has been with the New York, New Haven & Hartford, he having entered its employ as a fireman in May, 1889, later being made an engineman. In 1900 he was transferred to the mechanical department as an air brake inspector. Three years later he was appointed foreman of engines and in August, 1904, was promoted to master mechanic. He subsequently served as general inspector of the mechanical department and in May, 1913, was appointed assistant mechanical superintendent. The following September he was appointed superintendent of the Old Colony division and in November, 1914, was selected to organize and supervise the bureau of fuel economy on the same road, with the title of assistant mechanical superintendent. He subsequently served as superintendent, first of the Shore Line division and later of the New Haven division, until May, 1917, when he was appointed general superintendent of the lines west. From September, 1917, to May, 1918, he was temporarily in the employ of the International Shipbuilding Corporation, engaged in government work at Hog Island, as transportation manager, and from May, 1918, until his recent appointment, he was transportation superintendent of the New Haven.

Harry C. Oviatt

J. E. INGLING, road foreman of engines of the Erie Railroad, with headquarters at Jersey City, N. J., has been appointed inspector of locomotive service, lines east of Salamanca, N. Y., with headquarters at 50 Church street, New York, succeeding V. C. Randolph, furloughed.

M. S. MONTGOMERY has been appointed fuel supervisor of the Northern Pacific, with headquarters at St. Paul, Minn.

G. E. MURRAY, chief electrician of the Chicago & North Western, with headquarters at Chicago, has resigned to

become electrical and mechanical engineer of the Grand Trunk Western Lines, with headquarters at Battle Creek, Mich.

J. E. O'Brien, mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis, Mo., has had his jurisdiction extended over the Memphis, Dallas & Gulf.

J. E. O'Hearne has resigned as superintendent of motive power of the Chicago & Alton.

Irving A. Peters, foreman of the electrical department of the Chicago & North Western at the Chicago shops, has been appointed to succeed J. E. Murray as chief electrician of the entire system under the jurisdiction of the mechanical department.

James Powell, chief draftsman of the motive power department of the Grand Trunk, has resigned under the superannuation plan, after 36 years of service, and has accepted a position as instructor of mechanical drawing at the Technical School, Montreal, Que., for the vocational training of returned soldiers, under the Canadian Government Civil Service Hospital Commission. Mr. Powell is also secretary of the Canadian Railway Club. He was succeeded as chief draftsman of the motive power department of the Grand Trunk by W. A. Booth, his former assistant.

G. C. Wilson, electrical engineer of the Union Pacific, with headquarters at Omaha, Neb., has been appointed electrical engineer of the Central of Georgia, with headquarters at Savannah, Ga.

C. D. Young, superintendent of motive power of the Pennsylvania Railroad, with office at Wilmington, Del., has been commissioned a lieutenant-colonel in the Transportation Corps, Engineers.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

R. E. Bell, division master mechanic of the Gulf, Colorado & Santa Fe at Galveston, Tex., has been appointed joint master mechanic of the Galveston Terminal Association.

W. C. Burel has been appointed master mechanic of the Pittsburgh division of the Baltimore & Ohio, Eastern Lines, with headquarters at Glenwood, Pa., succeeding A. H. Hodges, transferred.

M. A. Carney, road foreman of engines of the Baltimore & Ohio at Keyser, W. Va., has been appointed trainmaster, with office at the same point.

L. C. Clamblitt, assistant road foreman of engines of the Baltimore & Ohio, Eastern Lines, with office at Cumberland, Md., has been appointed road foreman of engines with headquarters at Keyser, W. Va.

T. E. Cullen has been appointed assistant master mechanic of the Erie at Briar Hill, Youngstown, Ohio, succeeding R. R. Munn, resigned.

Charles Emerson has been appointed master mechanic of the Fargo division of the Northern Pacific, with office at Dilworth, Minn., in place of R. P. Blake, transferred.

O. A. Garber, master mechanic of the Illinois Central at East St. Louis, Ill., has been transferred to Waterloo, Iowa, as master mechanic of the Minnesota and Iowa divisions, succeeding Norman Bell, resigned to enter military service.

A. H. Hodges, master mechanic of the Baltimore & Ohio, Eastern Lines, with office at Glenwood, Pittsburgh, Pa., has been appointed master mechanic at Keyser, W. Va.

J. F. Kimbell, division foreman of the El Paso & Southwestern at Carrizozo, N. M., has been appointed master mechanic of the Western division, with headquarters at Douglas, Ariz., in place of F. P. Roesch, resigned.

J. L. Riley, general foreman of the Chicago, St. Paul, Minneapolis & Omaha at Sioux City, Iowa, has been appointed master mechanic at Sioux City, succeeding J. O. Enockson.

Maynard Robinson, division master mechanic of the Gulf, Colorado & Santa Fe at Temple, Tex., has had his jurisdiction extended to include the old Galveston division. The Galveston and Southern divisions have been combined and will be known as the Southern division.

G. J. Wentz has been appointed master mechanic of the Montana, Wyoming & Southern, with office at Belfry, Mont., succeeding H. R. French, resigned.

Arthur Williamson, road foreman of engines on the Western Maryland, with office at Hagerstown, Md., has been appointed superintendent of the Elkins division of the Western Maryland, the Cumberland Valley, and the Cumberland & Pennsylvania Railroad, with headquarters at Cumberland, Md., succeeding J. F. Chisholm, deceased.

CAR DEPARTMENT

E. N. Fackler, formerly car inspector of the Philadelphia & Reading, has been appointed assistant chief car inspector at Reading, Pa.

Charles E. Peiffer, general car supervisor of the Buffalo, Rochester & Pittsburgh, at Du Bois, Pa., is now master car builder, with headquarters at the same place.

W. J. Robider, master car builder of the Central of Georgia, with office at Savannah, Ga., has been appointed general master car builder of the Canadian Pacific, with headquarters at Montreal, Que., succeeding C. W. VanBuren, deceased. Mr. Robider was born on February 15, 1869, at Savannah, Ga., and entered the service of the Central of Georgia as an apprentice in the car department in October, 1884. He subsequently served as foreman in the passenger shop and then as general foreman of the car department. In October, 1905, he was promoted to master car builder and since the government took control of the railroads in the United States, he has served as an alternate member of the Committee of Standards and Inspection. His appointment as general master car builder of the Canadian Pacific became effective on October 15.

Irvin Zuber, formerly a car inspector of the Philadelphia & Reading, has been appointed foreman car inspector, at Reading, Pa.

SHOP AND ENGINEHOUSE

William S. Addington has been appointed night roundhouse foreman of the Chicago, Rock Island & Pacific at Haileyville, Okla., succeeding William La Rue.

A. J. Lewis, general foreman of the Missouri, Kansas & Texas of Texas, has been appointed shop superintendent at Denison, Tex.

G. E. Lund has been appointed general foreman of the Erie Railroad at Hammond, Ind., succeeding C. Roth, transferred.

C. B. Smith has been appointed general foreman of the locomotive department on the Philadelphia division of the Baltimore & Ohio, with office at Philadelphia, Pa.

Henry E. Wienke has been appointed machine foreman at the Huntington, Ind., shops of the Erie, succeeding Charles Clabaugh, transferred.

PURCHASING AND STOREKEEPING

R. L. Irwin, purchasing agent of the Texas & Pacific, the St. Louis Southwestern of Texas, and other lines under the authority of Federal Manager J. L. Lancaster, with office at

Dallas, Tex., has had his jurisdiction extended to include the Dallas Terminal Railroad & Union Depot.

J. L. BENNETT, purchasing agent of the Central of Georgia, has been appointed purchasing agent also of the Wrightsville & Tennille, the Louisville & Wadley, the Sylvania Central, and the Wadley Southern, with headquarters at Savannah, Ga.

F. A. BUSHNELL, purchasing agent of the Great Northern with headquarters at St. Paul, Minn., and also a member of the Northwestern Regional Purchasing Committee, has had his jurisdiction extended over the Farmers Grain & Shipping Railroad, with headquarters at St. Paul.

CHARLES A. HOW, purchasing agent of the Missouri Pacific, the St. Louis Southwestern and the Louisiana & Arkansas, with headquarters at St. Louis, Mo., has had his jurisdiction extended over the Memphis, Dallas & Gulf, with the same headquarters.

N. P. RANDOLPH, purchasing agent of the Southern Pacific Terminal Company and the Galveston Wharf Company, with headquarters at New Orleans, La., will also have authority over all Galveston terminals.

I. SEDDON, purchasing agent of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn., has been appointed also purchasing agent of the St. Paul Union Depot, the Minneapolis Eastern and the Minnesota Transfer, with the same headquarters.

COMMISSION APPOINTMENT

S. A. CHAMBERLAIN, senior inspector of motive power of the Interstate Commerce Commission at Chicago, has been promoted to succeed John R. Thompson as senior mechanical engineer in the central district of the Bureau of Valuation, Chicago.

JOHN A. SHIRLEY, who has been district inspector of locomotive boilers for the Interstate Commerce Commission at San Antonio, Tex., since 1911, has been nominated by the President for appointment as assistant chief inspector, succeeding Garland P. Robinson, resigned.

JOHN R. THOMPSON, senior mechanical engineer for the Interstate Commerce Commission, in the central district of the Bureau of Valuation, Chicago, in charge of mechanical and electrical branches, has resigned to take a commission as captain in the engineer corps of the army.

OBITUARY

JOHN MCMANAMY, general supervisor of equipment of the mechanical department of the Railroad Administration, and a brother of Frank McManamy, assistant director, Division of Operation, died suddenly at his home at Grand Rapids, Mich., on November 13, of pneumonia.

F. W. TAYLOR, mechanical superintendent of the Missouri, Kansas & Texas of Texas, and the other lines under the jurisdiction of J. S. Pyeatt as federal manager, died on November 14, at the age of 43. Mr. Taylor began his railroad career as a call boy with the Illinois Central at Water Valley, Miss., in 1892, and remained with that road in various capacities until December 31, 1914, at which time he was acting as master mechanic at Mattoon, Ill. From January 1, 1915, to January 1, 1917, he was superintendent of motive power of the International & Great Northern. On the latter date he was appointed superintendent of motive power of the Missouri, Kansas & Texas System and early in 1918 was made general manager of the Missouri, Kansas & Texas. He held this position until the government took over the railroads, when he was appointed mechanical superintendent of the lines controlled by Mr. Pyeatt and he served in this capacity until the time of his death.

SUPPLY TRADE NOTES

The Grip Nut Company, Railway Exchange building, Chicago, announces its removal to 943 Peoples Gas building.

William T. Van Dorn, president of the Van Dorn Automatic Coupler Company, Chicago, died at his home in that city November 29.

William Casey, formerly manager of the Canadian Locomotive Company, Ltd., Kingston, Ont., has been appointed to the position of general manager.

J. D. Apgar, formerly with Vandyck Churchill Company, in New York territory, is now associated with the Machine Tool Engineering Company, New York City.

Leonard C. McChesney, advertising manager for the Thomas A. Edison industries for 16 years, died of heart disease November 10, at his home in Orange, N. J.

L. C. Sprague, district manager of sales of the Chicago Pneumatic Tool Company, at New York, has been appointed assistant secretary with headquarters at 52 Vanderbilt avenue in that city.

Francis Jordan, sales engineer for the George Cutter Company, of South Bend, Ind., with headquarters at Chicago, has resigned to go with the Wilson Welder & Metals Company at New York.

The Washington (D. C.) offices of the Austin Company have been moved to 1406 G street, N. W. C. F. Chard, formerly of the Philadelphia office of this company, will be in charge of this office.

E. C. Carroll, sales representative of the National Carbon Company, with headquarters at Chicago, has resigned to enter the production department of the Globe Seamless Steel Tubes Company at Milwaukee, Wis., effective November 1.

Major E. Tyden, vice-president of the International Seal & Lock Company, Chicago, has been promoted to lieutenant-colonel in the Division of Ordnance. Colonel Tyden is located at Rock Island, Ill., as production manager of the Rock Island arsenal.

The Walter A. Zelnicker Supply Company, St. Louis, Mo., announces the appointment of Joseph Meyerson as secretary to the president. Mr. Meyerson was associated for 10 years with the Southwestern Tariff Bureau, latterly as secretary to F. A. Leland.

The Q and C Company of Canada, Limited, has been incorporated with Charles F. Quincy, president, and Frank F. Kister, secretary and treasurer. This company will manufacture and sell in Canada railway devices controlled by the Q and C Company.

The Hall-Scott Motor Company will build an addition to its machine shop at Berkeley, Cal., which will be of concrete construction and will cost about $40,000. Upon the completion of this building the company will have a total area of 31,250 sq. ft. for shop use.

H. D. Megary, assistant to the president of the Chicago Pneumatic Tool Company, with headquarters at Chicago, has been elected secretary, with the same headquarters, succeeding W. B. Seelig, resigned. Mr. Megary will continue to act as assistant to the president.

J. Weinland, district manager of the Liberty Steel Products Company at Chicago, has been appointed assistant to the president of that company and the Davis Brake Beam Company, with headquarters at New York. S. W. Midgley, in

charge of the railroad department of the Liberty Steel Products Company, with office at Chicago, succeeded Mr. Weinland as district manager.

In order to have a name more descriptive of the products it manufactures, the Cleveland Galvanizing Works Company, with general offices and plant at Cleveland, Ohio, will be known in the future as the Chain Products Company. The company, under its old name, has been in business since 1886.

C. B. Matthai, an attorney for the Union Pacific corporate organization, has been elected secretary of the McKeen Motor Car Company, of Omaha, Neb. He succeeds C. W. Y. Loucks, who resigned recently as secretary and sales manager to enter the officers' training camp at Plattsburg, N. Y.

At a special meeting of the board of directors of the Independent Pneumatic Tool Company held in Chicago, October 30, Roger C. Sullivan was appointed a director and elected chairman of the board and a member of the executive committee, to fill vacancies caused by the death of the late John P. Hopkins.

At a meeting of the board of directors of Fairbanks, Morse & Co., at Chicago, November 13, R. H. Morse was elected vice-president in general charge of purchasing and traffic, and will also continue as a director; C. W. Pank, general director of sales, was elected vice-president in charge of sales of all factory products; W. S. Hovey, general manager of the plant in Beloit, Wis., was elected vice-president in charge of general manufacturing at all factories; W. E. Miller, first vice-president, was elected vice-president and treasurer, and F. M. Boughey, retired as treasurer to become secretary and controller; all with headquarters at Chicago.

Charles G. Du Bois has been elected vice-president of the Western Electric Company, Inc. Mr. Du Bois entered the employ of the company in 1891 at its New York office, and occupied successively the positions of chief clerk, secretary and supervisor of branch houses. In 1907 he became comptroller of the American Telephone & Telegraph Company and in this capacity inaugurated and supervised a comprehensive system of accounting for the Bell telephone system. During the winter of 1917-1918, Mr. Du Bois was in Washington as comptroller of the American Red Cross, which position he still retains. Mr. Du Bois is 48 years of age and graduated from Dartmouth College in 1891. He is a director of the Western Electric Company, Inc., and other corporations.

Latin-American Demand for American Steel

Latin-American concerns wishing to specify American structural steel for building and railway purposes can now do so without difficulty by referring to pamphlets in Spanish and English, just issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. These pamphlets are intended to facilitate sales of such materials in Latin countries, and are published in response to numerous requests from those countries.

The five pamphlets announced are, "Standard Specifications for Structural Steel for Buildings," Industrial Standards No. 8; "Standard Specifications for Structural Steel for Locomotives," Industrial Standards No. 9; "Standard Specifications for Carbon Steel Bars for Railway Springs," Industrial Standards No. 10; "Standard Specifications for Quenched and Tempered Carbon-Steel Axles, Shafts, and Other Forgings for Locomotives and Cars," Industrial Standards No. 12; and "Standard Specifications for Carbon Steel Forgings for Locomotives," Industrial Standards No. 13. These can be purchased at five cents a copy from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce.

CATALOGUES

FLANGE OILERS.—The Detroit Lubricator Company, Detroit, Mich., has issued catalogue F-6, illustrating and describing the Detroit automatic flange oiler.

LOCOMOTIVE LUBRICATORS.—The Detroit Lubricator Company, Detroit, Mich., has published a 62-page catalogue covering the Detroit Bullseye locomotive lubricators and other locomotive specialties manufactured by this company.

GUN IRON.—Why Railroads Use Hunt-Spiller Gun Iron, is the title of an eight-page booklet published by the Hunt-Spiller Manufacturing Corporation, South Boston, Mass. It contains a brief discussion of the merits of gun iron which led to recognition of its value in locomotive construction by the railroads several years ago.

PORTABLE CRANES AND HOISTS.—The complete line of portable floor cranes and hoists manufactured by the Canton Foundry & Machine Company, Canton, Ohio, is listed in a 34-page catalogue issued by that company. The construction and operation of the cranes is described in detail and each type is illustrated and the principal dimensions given.

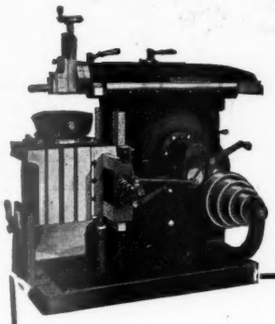
HEAT INSULATION.—Nonpareil high-pressure blocks and cement for heat insulation is the subject of a 20-page catalogue published by the Armstrong Cork & Insulation Company, Pittsburgh, Pa. This material is used for insulating boilers, ovens, feedwater heaters, tanks, etc., and various installations in which Nonpareil blocks or cement were used are illustrated in the catalogue.

COAL GATES.—Catalogue No. 37 of the Beaumont Manufacturing Company, Philadelphia, Pa., illustrates and describes the Beaumont standard types of gates for controlling the flow of coal, ashes, coke, etc., from bins and pockets. The purpose of the catalogue is to present the results of the company's experience in designing and installing gates for varied purposes and the types illustrated in the catalogue have been adopted as standard.

INSULATING BRICK.—The Armstrong Cork & Insulation Company, Pittsburgh, Pa., has published a four-page leaflet which describes the composition of Nonpareil insulating brick for furnaces and ovens, and cites an instance in support of a claim that Nonpareil insulating brick will save from 60 to 75 per cent of the heat ordinarily lost by conduction and radiation and makes it possible to attain a desired temperature in less time than would otherwise be required.

ELECTRICAL MEASURING INSTRUMENTS.—The Potentiometer System of Pyrometry and Temperature Control is the title of a 60-page catalogue published by the Leeds & Northrup Company, Philadelphia, Pa., to describe its system of pyrometry and temperature control, in which the potentiometer method is employed for measuring the electromotive force of thermocouples. The catalogue contains many illustrations, and other electrical measuring instruments manufactured by the Leeds & Northrup Company are also described.

SUPERHEATER UNIT MAINTENANCE.—This is the title of an eight-page pamphlet issued by the Locomotive Superheater Company, New York, describing the principles pertaining to the care and operation of the locomotive which prevent the necessity of repairs to the superheater units. Some of the matters dealt with are the necessity for clean flues, the effects of high water, the maintenance of the damper and the ball ends, etc. The pamphlet is illustrated with a number of sketches and photographs of tools that are especially adapted to the work of repairing and maintaining superheater units.



Steptoe Shapers

THESE machines represent seventy-three years of eperience in the manufacturing of High-Grade Machine Tools. Thousands of machines in shops giving daily satisfaction are a guarantee of quality that should not be overlooked when buying your equipment.

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ARMSTRONG
DROP FORGED STEEL **WRENCHES**

ALL SHAPES AND SIZES IN STOCK

CORRECT DESIGN, CAREFULLY FORGED and ACCURATELY MACHINED.

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ARMSTRONG TOOL HOLDERS WON THE ONLY *GRAND PRIZE* awarded in the special class for Tool Holders at the Panama-Pacific Exposition.

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BARBER-COLMAN
MILLING CUTTERS
Quality and Accuracy Guaranteed

SPECIAL AND STANDARD FORMS

BARBER-COLMAN COMPANY

Rockford, Ill., U.S.A.

BRIDGEFORD

From Start to Finish

CONSERVATION of material—conservation of manpower in machining crank pins out of scrap axles on the Bridgeford Heavy Duty Engine Lathe.

This sturdy machine is the result of years of experience in design and construction of heavy lathe building.

Accurate for finishing cuts, powerful for heavy stock removal—the Bridgeford is a strong favorite in railroad shops.

Ask us what a Bridgeford will do in your shop. A postal will bring full information.

BRIDGEFORD MACHINE TOOL WORKS

153 Winton Road **Rochester, N. Y.**

AMERICAN

"The Best Machine We Ever Had"

"THE best machine we ever had," said the General Foreman of this busy shop in speaking of the "American" lathe.

The big back end main rod brass shown in the picture is chucked, bored to fit and faced to proper thickness in one hour. Is there any doubt why the General Foreman should be enthusiastic over the "American"?

Where production demands are exacting and standards are high, you'll find "American" tools meeting these demands with uninterrupted reliability. The wide range of usefulness and adaptability of these tools is the answer to keeping down production costs under the ever-increasing labor and material costs.

Let us tell you about the features which impressed this General Foreman so favorably—send your address—a postal will do.

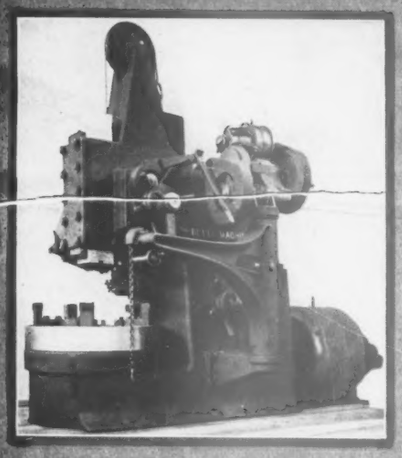
THE AMERICAN TOOL WORKS CO.

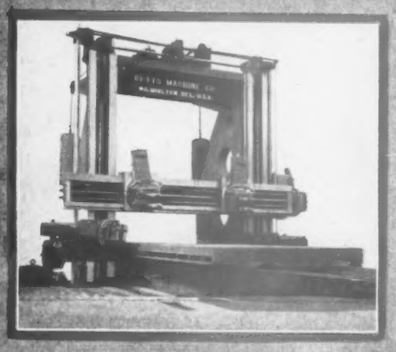
Cincinnati, U. S. A.

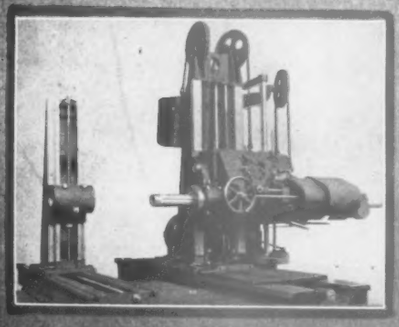
Lathes—Planers *Shapers—Radials*

BETTS

Heavy Duty







FIFTY-SEVEN years' experience in building the highest type of Heavy Duty Machine Tools has resulted in the production of a line of Railroad and Industrial Tools which are in universal demand the world over.

Betts Tools are installed in the most important Railway, Locomotive and Car Shops, and big Industrial Plants and in the Forge Shops and Steel Mills all over the World, rendering the kind of service which has resulted in this demand.

Betts Machine Tools were being built and used by the most important Railroad Systems a long time before many of the present machine tool builders were born, and they have kept steady pace with every improvement.

BETTS MACHI

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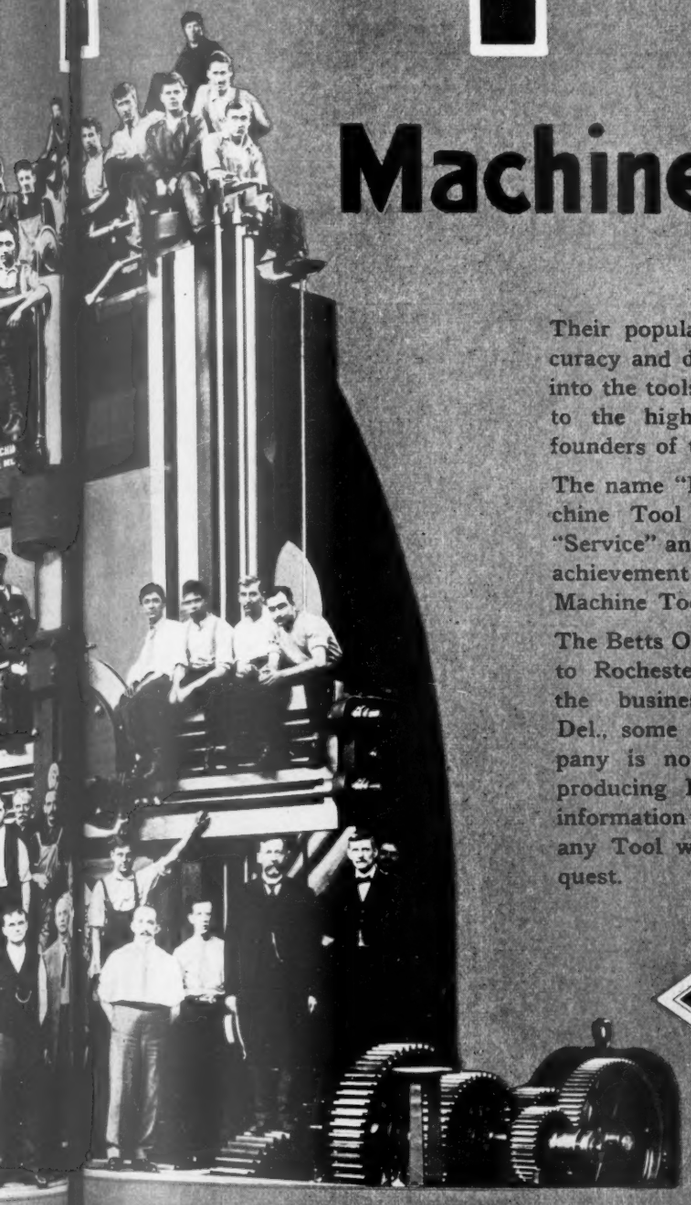
Machine Tools

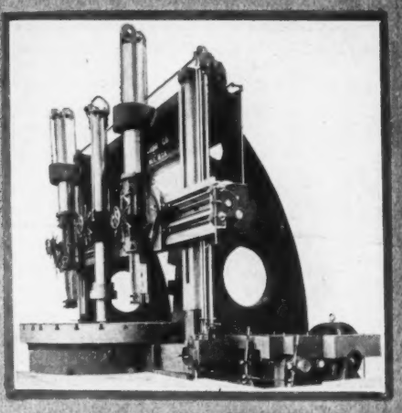


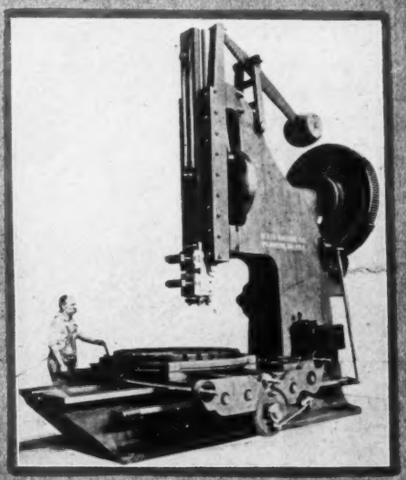
Their popularity is due to the accuracy and durability which is built into the tools, and a rigid adherence to the high standard set by the founders of the Betts Company.

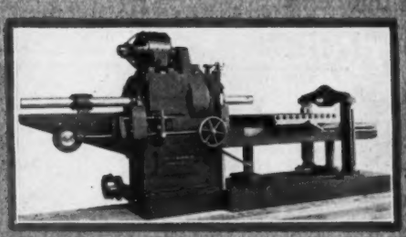
The name "Betts" applied to a Machine Tool means "Quality" and "Service" and represents the highest achievement in modern Heavy Duty Machine Tools.

The Betts Organization was brought to Rochester with the removal of the business from Wilmington, Del., some time ago and the company is now actively engaged in producing Betts Tools. Complete information and specifications on any Tool will be forwarded on request.

HEAVY BETTS DUTY







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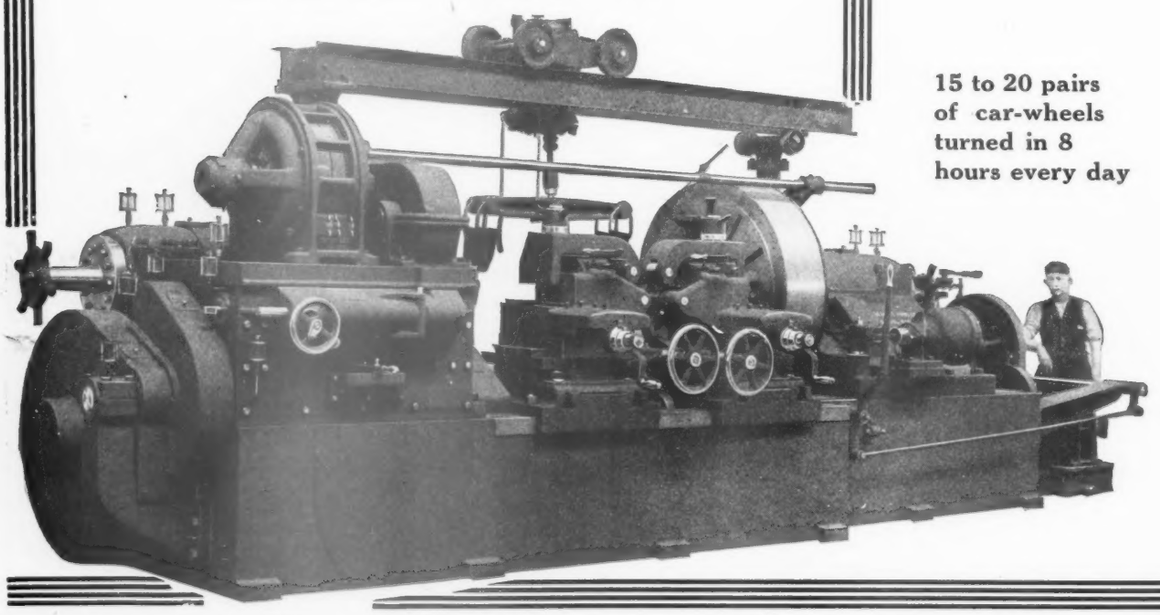
And now for "Reconstruction"

TO the railroad shops of America, getting back to a peace basis means the replacement of a lot of worn-out equipment that four years of war service has prematurely prepared for the scrap heap.

We are ready to help you with this problem of shop reconstruction. Important developments in our various designs make it possible to re-equip you with improved machinery by which record output figures of a few years ago can be bettered as a matter of course.

Among the special Niles-Bement-Pond equipment that has been acid tested in America's largest railroad shops are our car-wheel lathes, driving-wheel lathes, axle lathes, axle cutting-off and centering machines, car-wheel borers, wheel presses, cylinder borers and rod millers.

Catalogues, circulars and interesting data of recent accomplishments furnished on request.



15 to 20 pairs of car-wheels turned in 8 hours every day

Electric Travelling Cranes - Steam Hammers

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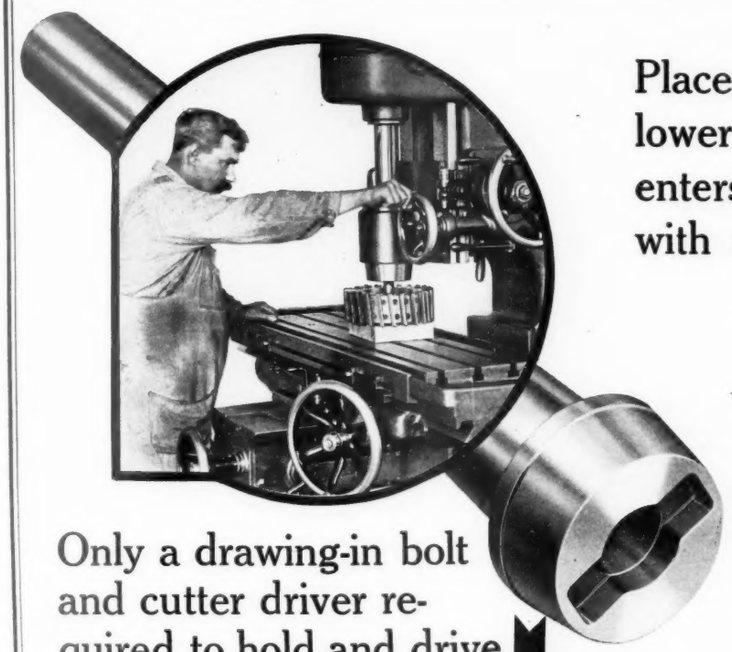


Place cutter on table, lower spindle until nose enters cutter, fasten with drawing-in bolt—

Simple, isn't it?

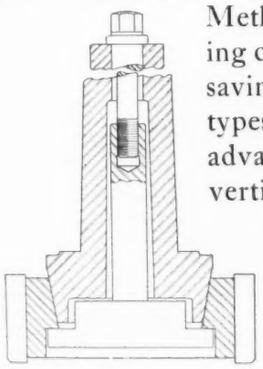
And it is just as simple as it sounds to put a face milling cutter of any size on

Brown & Sharpe Vertical Spindle Milling Machines

because of the taper-nose construction of the spindle.

Only a drawing-in bolt and cutter driver required to hold and drive face milling cutters

ON Brown & Sharpe Milling Machines because of the taper-nose construction of the spindle. Method of attaching cutter is a time-saving feature on all types and especially advantageous on the vertical spindle machines. Diagram shows method of holding and driving cutter by means of cutter driver and drawing-in bolt.



When in place the cutter driver serves as a clutch and assures a positive drive.

Let us tell you in detail of this and the many other features of

Brown & Sharpe Milling Machines

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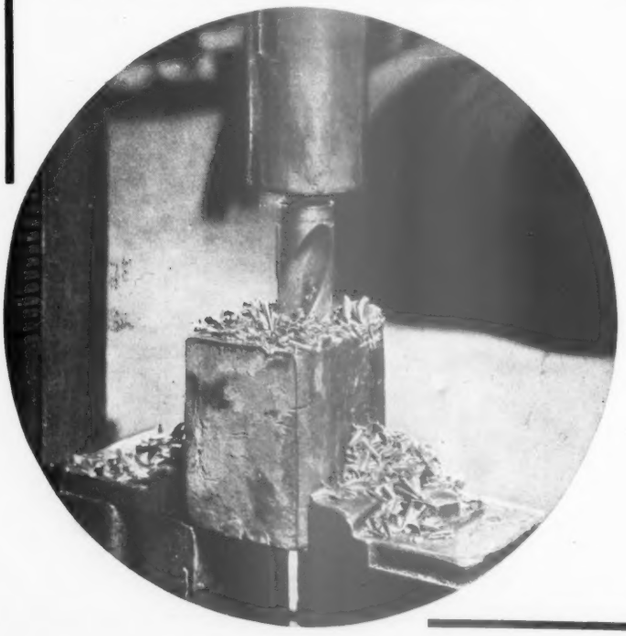
Built to stand hard and productive service. In railroad shops and roundhouses where the turning of power depends on machine production, you will find the "Aurora" the ideal tool.

Designed for quick changes, with ample power to secure maximum drill cutting capacity, the Aurora delivers "satisfaction" every hour in the day.



The construction of "Aurora" upright drills is the most rigid possible with highest grade material used throughout. This insures handling of many jobs which are really beyond rated capacity. Operators like to use "Aurora" upright drills.

Speed and feeds are positive and so arranged as to secure maximum output with the minimum effort.

Many distinctive Aurora features appeal to the discriminating railroad man. May we tell you "why"?

The Aurora Tool Works
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NILES-BEMENT-POND CO.
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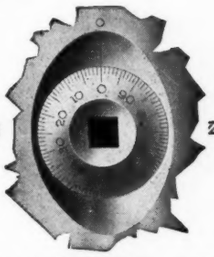
Improved "Two-in-One" Davis Expansion Car Wheel Boring Tools

These tools have set a standard for correct wheel boring. The double arrangement of cutters, one set for roughing and the other for finishing, insure absolute accuracy of bore and maximum production.

Correct wheel boring and fitting increases the mileage of car wheels and reduces the number of thin, chipped and broken flanges.

Reduce your wheel boring costs at least 25% by applying our tools. Full particulars sent on request.



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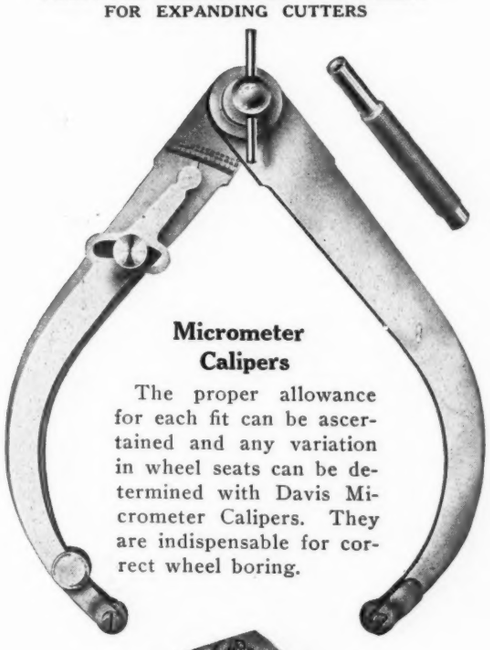
Special "Two-in-One" Davis Expansion Car Wheel Boring Tool

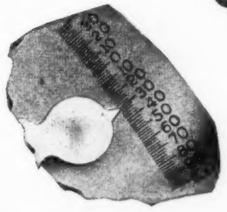
For Boring Steel or Cast-Iron Car Wheels

Tool No.	Size Tools Bore	Code Word for Tool
15½	3¼ to 4¼	Spltopaz
14½	3½ to 4½	Spltoben
13½	4 to 5¼	Spltory
12½	4½ to 5¾	Spltolek
11½	4¾ to 6	Spltofla
10½	5 to 6½	Spltoseg
9½	5¼ to 6¾	Spltotem
8½	5½ to 7¼	Spltoga
7½	6¼ to 7⅞	Spltokel
6½	6¾ to 8⅛	Spltower



Micrometer Calipers

The proper allowance for each fit can be ascertained and any variation in wheel seats can be determined with Davis Micrometer Calipers. They are indispensable for correct wheel boring.



GRADUATED SCALE

Regular "Two-in-One" Davis Expansion Car Wheel Boring Tool

For Boring Steel or Cast-Iron Car Wheels

Tool No.	Size Tools Bore	Code Word for Tool
15½	3¼ to 4¼	Topaz
14½	3½ to 4½	Toben
13½	4 to 5¼	Tory
12½	4½ to 5¾	Tolek
11½	4¾ to 6	Tofla
10½	5 to 6½	Toseg
9½	5¼ to 6¾	Totem
8½	5½ to 7¼	Toga
7½	6¼ to 7⅞	Tokel
6½	6¾ to 8⅛	Tower

DAVIS BORING TOOL Co., INC.

ST. LOUIS MO., U. S. A.

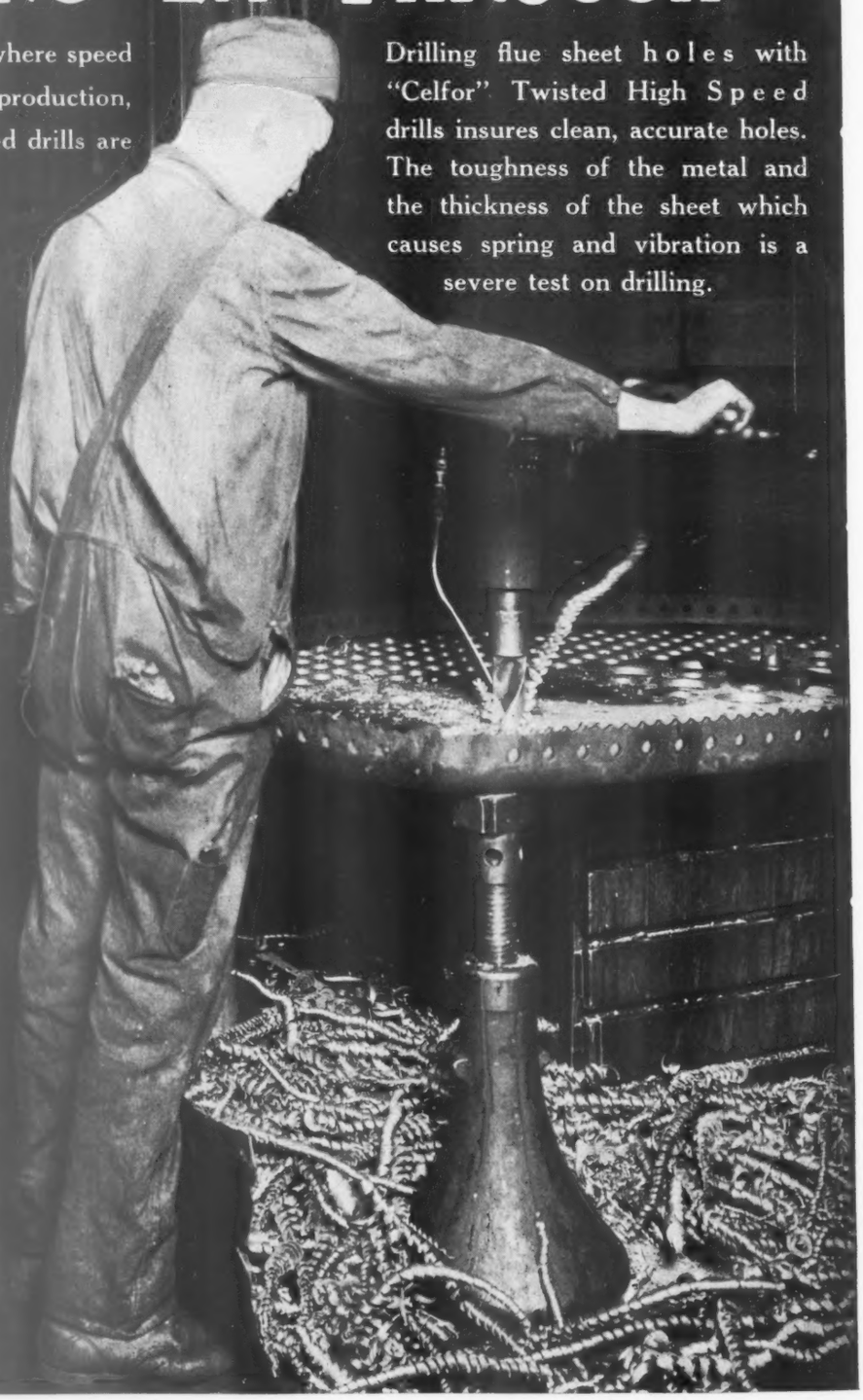
Address DEPT. R-C.

CELFOR

PUTTING 'EM THROUGH

For those short run jobs where speed is the vital factor of production, Celfor Twisted High Speed drills are the answer to maximum machine output.

Drilling flue sheet holes with "Celfor" Twisted High Speed drills insures clean, accurate holes. The toughness of the metal and the thickness of the sheet which causes spring and vibration is a severe test on drilling.



Flue sheet drilling is one of the many jobs in your shop where "Celfor" drilling reflects directly on increased output.

How "Celfor" drills will speed up your production, will solve your problems of ever-increasing shop costs, is described in catalog 16. May we send you a copy?

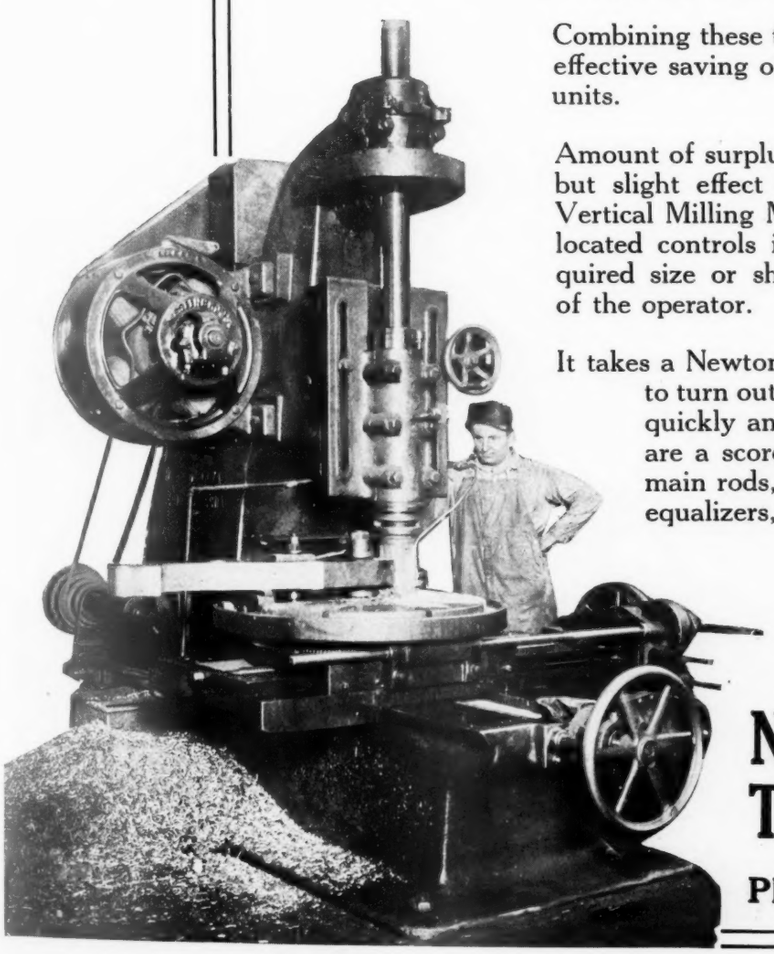
CLARK
Equipment Co.
Main Office and Works
BUCHANAN, MICH.

NEWTON

Removing Stock

In this busy Eastern shop, production is worked out on a scientific basis. This Newton Vertical Milling Machine is completing three operations in one:

1. **Removing surplus stock,**
2. **Finishing to line,**
3. **Leaving smooth surface.**



Combining these three operations means the effective saving of man power and machine units.

Amount of surplus stock to be removed has but slight effect on the powerful Newton Vertical Milling Machine. Simple and well located controls insure the finishing to required size or shape with minimum effort of the operator.

It takes a Newton Vertical Milling Machine to turn out accurate, high grade work, quickly and at the least cost. There are a score of jobs such as side and main rods, motion work arms, spring equalizers, boiler sheets, etc., where the installations of a "Newton" will soon reflect in greatly increased shop output. Just ask us for complete details.

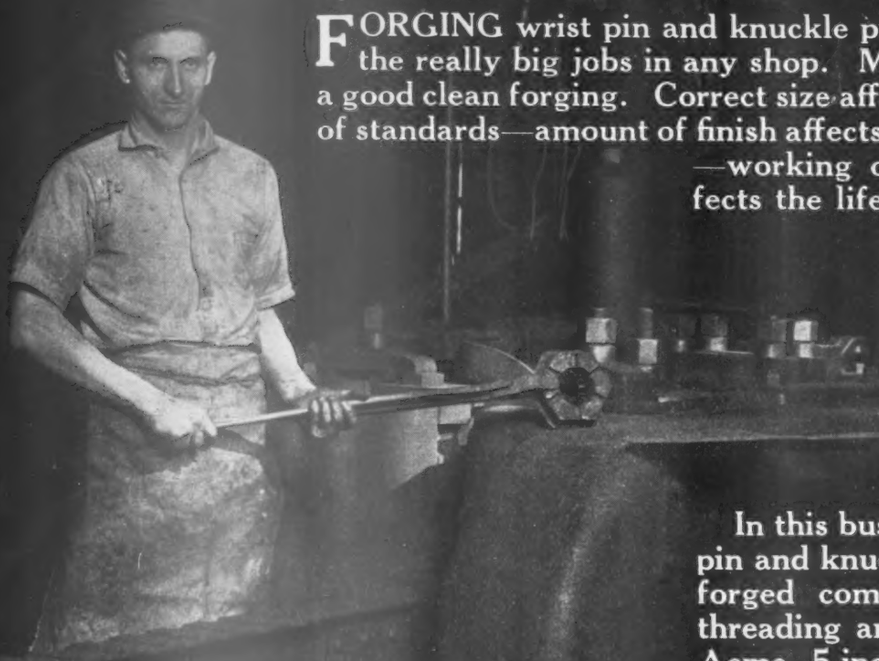
Newton Machine Tool Works, Inc.

Philadelphia U. S. A.

ACME

WHERE PRODUCTION DEMANDS ARE EXACTING

FORGING wrist pin and knuckle pin nuts is one of the really big jobs in any shop. Much depends on a good clean forging. Correct size affects maintaining of standards—amount of finish affects cost of finishing—working of the metal affects the life of the nut.



In this busy shop, all wrist pin and knuckle pin nuts are forged complete ready for threading and facing on the Acme 5-inch Forging Machine from bar stock. "It's a good clean job," proudly said the operator.

Many other intricate and otherwise costly jobs are forged in this machine too—that's one reason why output is maintained at the minimum cost.

There's many a forging job that can be handled more profitably on the "Acme." Ask us about the Acme line—we have a machine to meet your needs.

The Acme Machinery Company
Cleveland, Ohio

MACHINING LOCOMOTIVE DRIVING BOXES

"WHILE the work of machining locomotive driving boxes is a common operation in every shop, the..."

RAILWAY MECHANICAL ENGINEER,
Page 573, October, 1918.

Morton Draw Cut Shaper

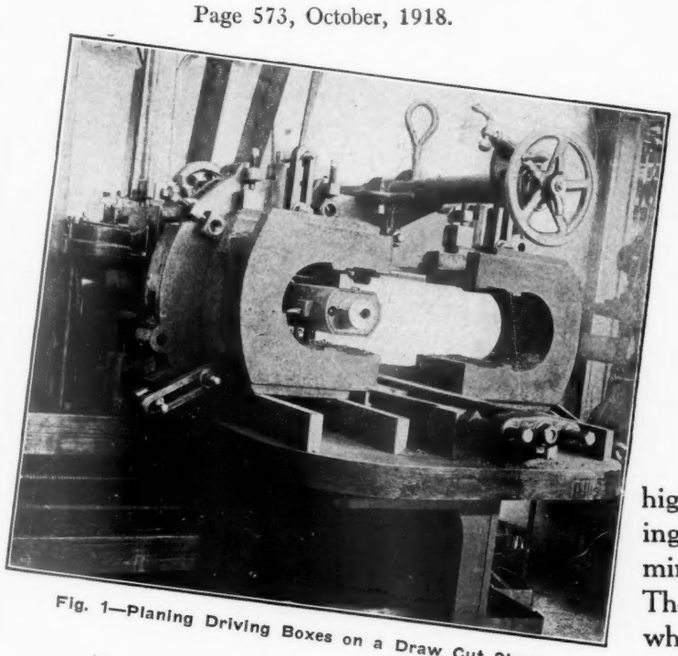


Fig. 1—Planing Driving Boxes on a Draw Cut Shaper

Solves the problem of keeping driving box repairs abreast of the output in this busy shop.

Driving boxes form a big item in maintenance to locomotives. You know the quantity you are forced to machine in a month — they are undoubtedly the most common job in your shop. In big shops—in shops where labor is scarce and wages high—the Morton draw cut shaper is proving its value in maintaining output at the minimum costs.

The Morton has many distinctive features which make it the ideal tool for general railroad shop work. May we send you complete details? Bulletin R-6 is waiting your address.

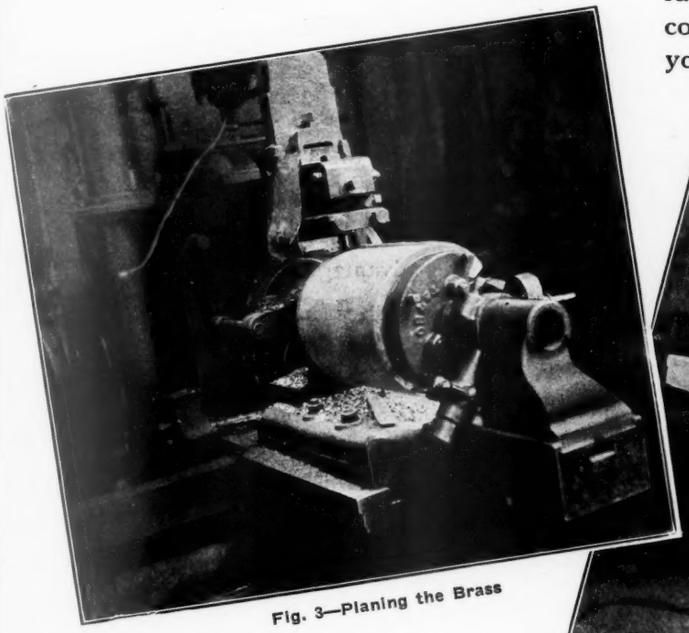


Fig. 3—Planing the Brass

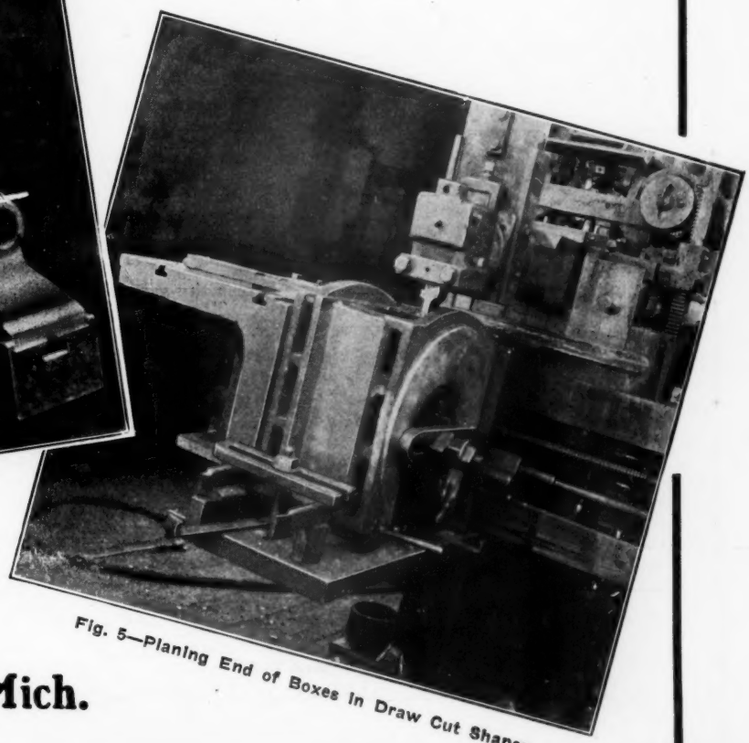
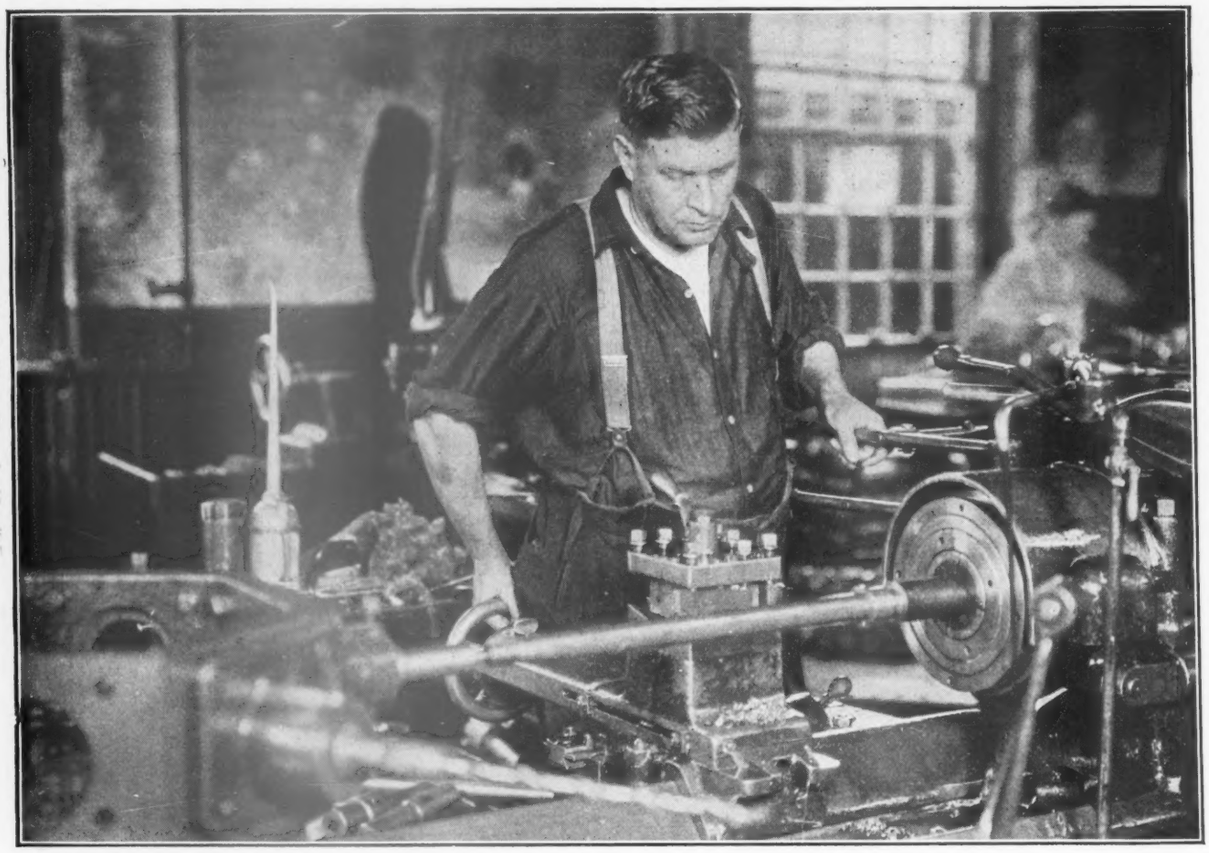
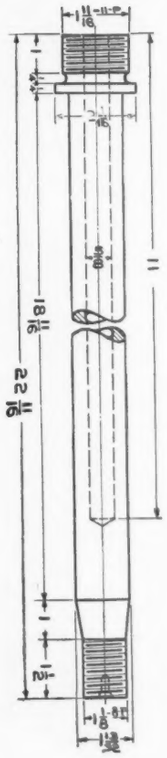


Fig. 5—Planing End of Boxes in Draw Cut Shaper

Morton Mfg. Company
Muskegon Heights, Mich.





A Difficult Railroad Job

This is a hard job. Yet one of the largest railroad shops in the East are making these "Air Brake Pump Pistons" of cold rolled stock, complete, day in and day out, *one each* 20 *minutes,* on a 3-A

Universal Hollow Hexagon Turret Lathe

The best time on another turret lathe without the advantage of the independent carriage was 40 minutes each.

Increased Production 100%

This one job demonstrates the superiority of these machines over those having a cross sliding head or turret. Then too, be sure you buy the original Universal Hollow Hexagon Turret Lathe.

The Operations

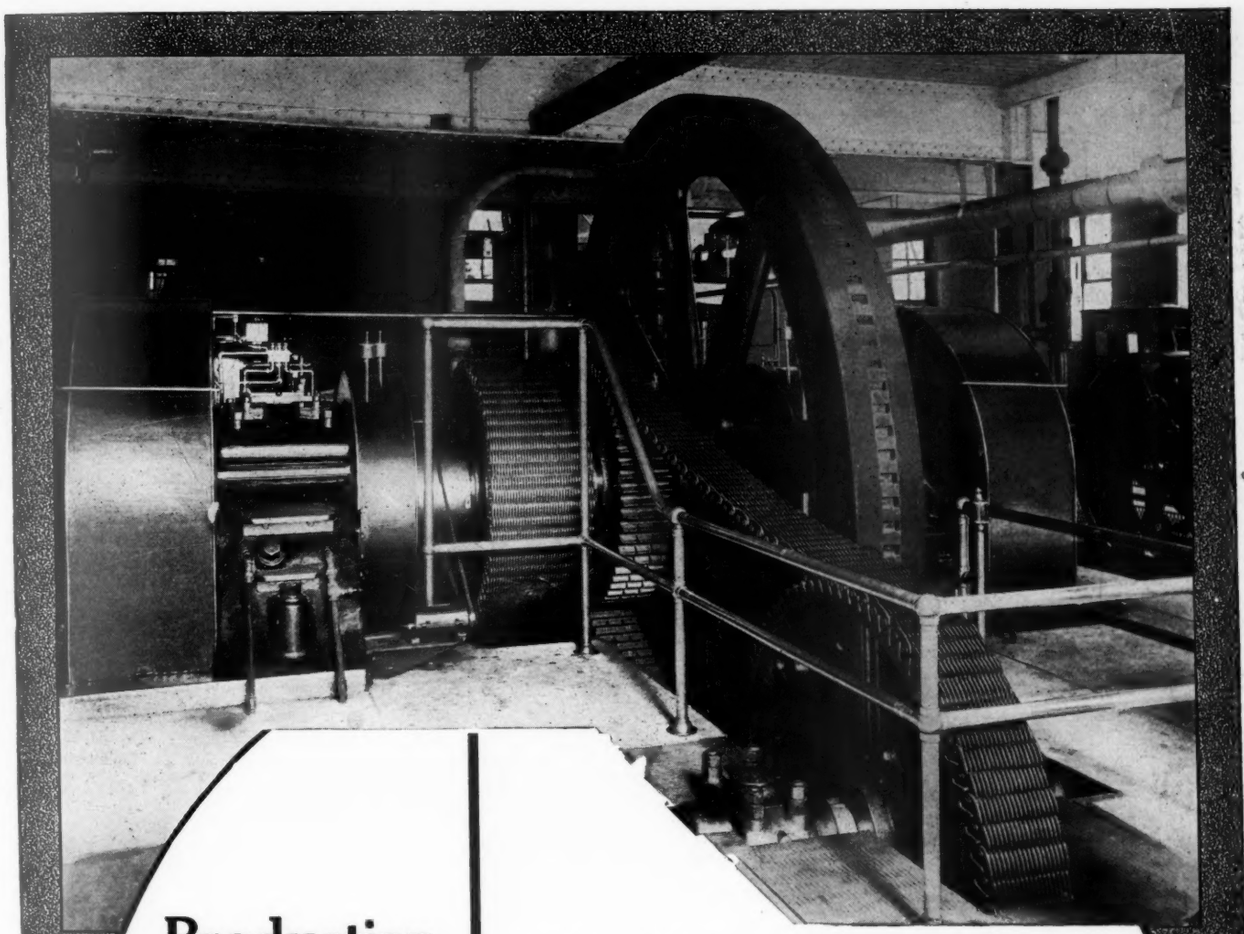
1st Shucking—Turn 1 13/32" diameter with Universal Turner, and at the same time turn back of the shoulder with the carriage. Next turn 1⅛" diameter with Universal Turner and turn taper with carriage. Then thread 1⅛" diameter with floating die head. 2nd Shucking—Drill ⅝" hole 11" long. Thread 1 11/16" diameter with floating die head.

Definite figures from your blueprints

THE WARNER & SWASEY COMPANY

CLEVELAND, OHIO

New York Office: Singer Building **Buffalo Office: Iroquois Building**
Boston Office: Oliver Building **Detroit Office: Ford Building**
Chicago Office and Salesroom: 618-622 Washington Boulevard



Production Cost and Profit Depend on Belting Efficiency

THE "MORSE" Rocker Joint Silent Chain is the only 99% efficient transmission known. The more severe the duty the more need of "MORSE" Drives. The Drive that will do the most work, the steadiest work, the best work—producing more at less COST. The Perfect Drive, flexible as a belt, positive as gears, oil baths not required. Continuity in operation, cost of production, and quality are the basis on which to select your drives. Let us have your general layout and design drives to save space, light, and power while increasing your production. Our booklet is illustrated with cuts of engines and drives and covers the subject of the number of teeth and links, lubricating and covering, chain and sprocket materials, chain widths, chain contacts, chain adjustments, etc. It will be sent free.

MORSE CHAIN COMPANY
ITHACA, NEW YORK
Our 1919 Vest Pocket Memo and Data Book Free to Officials and those in authority 10¢ to all others

MORSE CHAIN CO., Ithaca, N. Y.

Largest Manufacturers of Silent Chains in the World

MORSE ENGINEERING SERVICE

Address	Nearest Office
Boston, Mass.....141 Milk St.	Canada.....Jones & Glassco, Regis'd
Chicago, Ill..Merchants L. & T. Bldg.	Montreal, St. Nicholas Bldg.
Cleveland, Ohio.....Engineers' Bldg.	Toronto, Traders Bank Bldg.
Detroit, Mich....1003 Woodward Ave.	Kansas City, Mo.....Long Bldg.
Greensboro, N. C.....805 Ashboro St.	Morse Engineering Co.
New York.....50 Church St.	Minneapolis, Minn.....Third St. S.
Pittsburgh, Pa.....Westinghouse Bldg.	Strong-Scott Mfg. Co.
San Francisco, Cal...Monadnock Bldg.	**St. Louis, Mo.**.....Chemical Bldg.
Atlanta, Ga.....Chandler Bldg.	**Morse** Engineering Co.
Earl F. Scott, M. E.	

Licensees for Europe and the Eastern Hemisphere:
The Westinghouse Brake Co., Ltd., London, N.

ASSISTANCE WITHOUT OBLIGATION

MORSE CHAIN CO., ITHACA, N. Y., U. S. A.
Gentlemen: As per your advertisement in The Railway Mechanical Engineer 12-18
please send copy of Pub. No. 14, "Large Power Drives."

Company.....

Individual.....

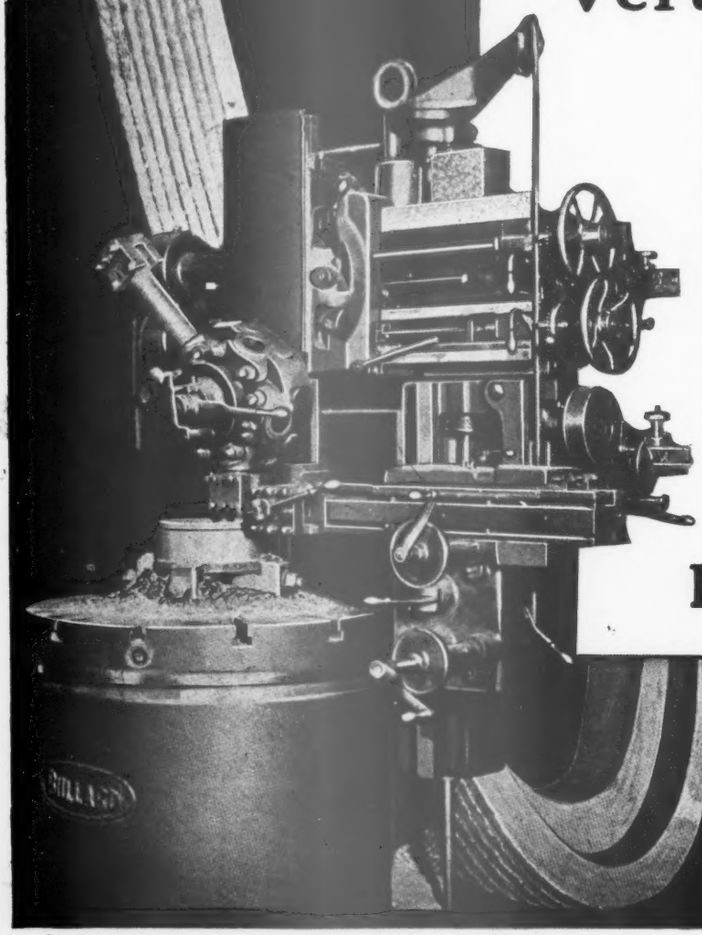
Position.....

Address.....

"You Can't Beat It For Production"

Thus spoke the shop foreman of a prominent railway shop in the South. He was commenting on output secured from the

BULLARD Vertical Turret Lathe



By eliminating lost motion, reducing cutting time through multiple tooling, development of speed and feed changes to the highest point of efficiency, the "Bullard" speeds up production per man to an extent that makes a worth while difference in labor costs.

The Bullard virtually protects you against a short labor market—an important consideration in view of the present labor famine.

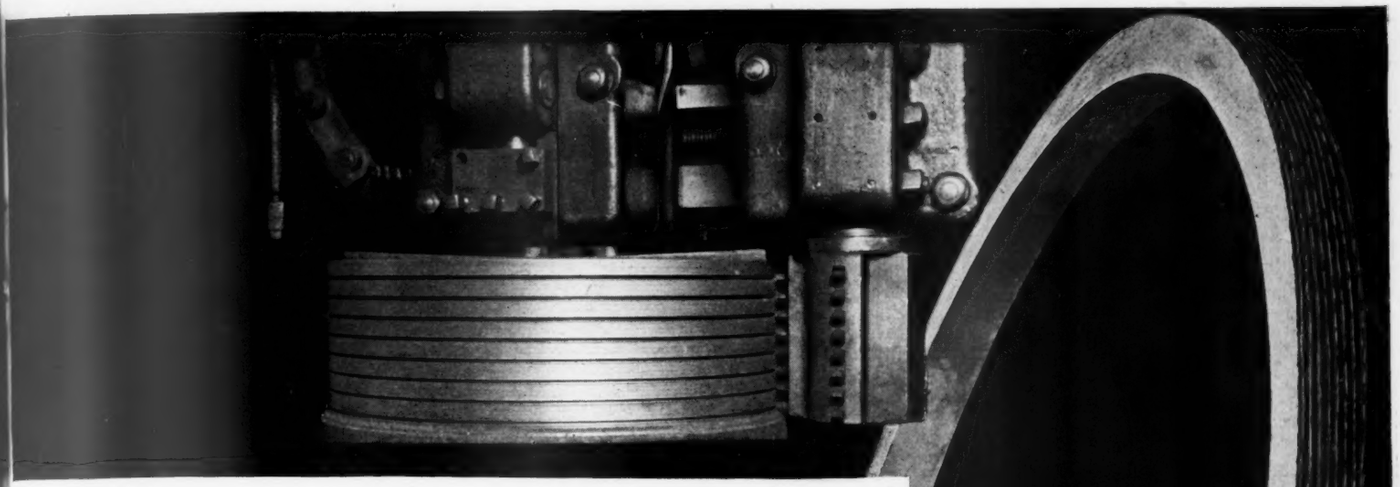
Manufacturing schedules or service reputation maintained—that is the welcome story where you find Bullard installations.

Machining forty-eight valve rings is no task for a day's work—it's a regular schedule with this "Bullard."

Bullard Machine Tool Co.,

BULLARD ★★★★★

IN THE NATIO



"You Have Said the Last Word In Machine Design When You Say Bullard"

This statement, made by the shop foreman of a prominent railway system, is but the echo of the expression you will hear in shops where they have one or more installations of

BULLARD Machine Tools

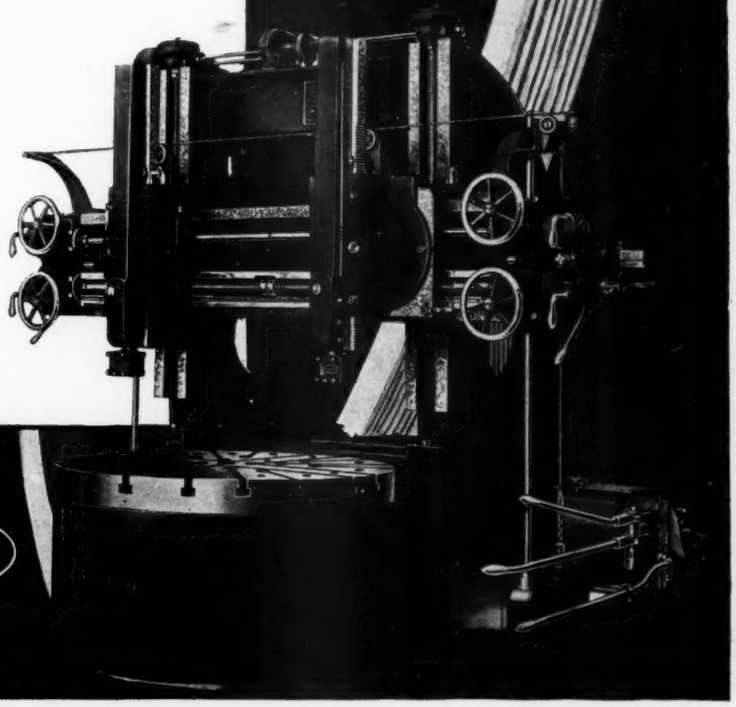
The Bullard 61" Maxi-Mill represents the best of what we have learned during the past thirty-five years of Vertical Boring and Turning Mill design and construction.

Every feature in the 61" Maxi-Mill has been proved good in these trying days of intensive production.

Chrome Nickel Gears and Shafts—Continuous Flow Lubrication—Centralized Control—Convenience Unequaled—Accuracy of the Highest Order and a Cutting Lubricant System that keeps the water out of the machine and off the floor, mark a real advance in boring and turning mill construction.

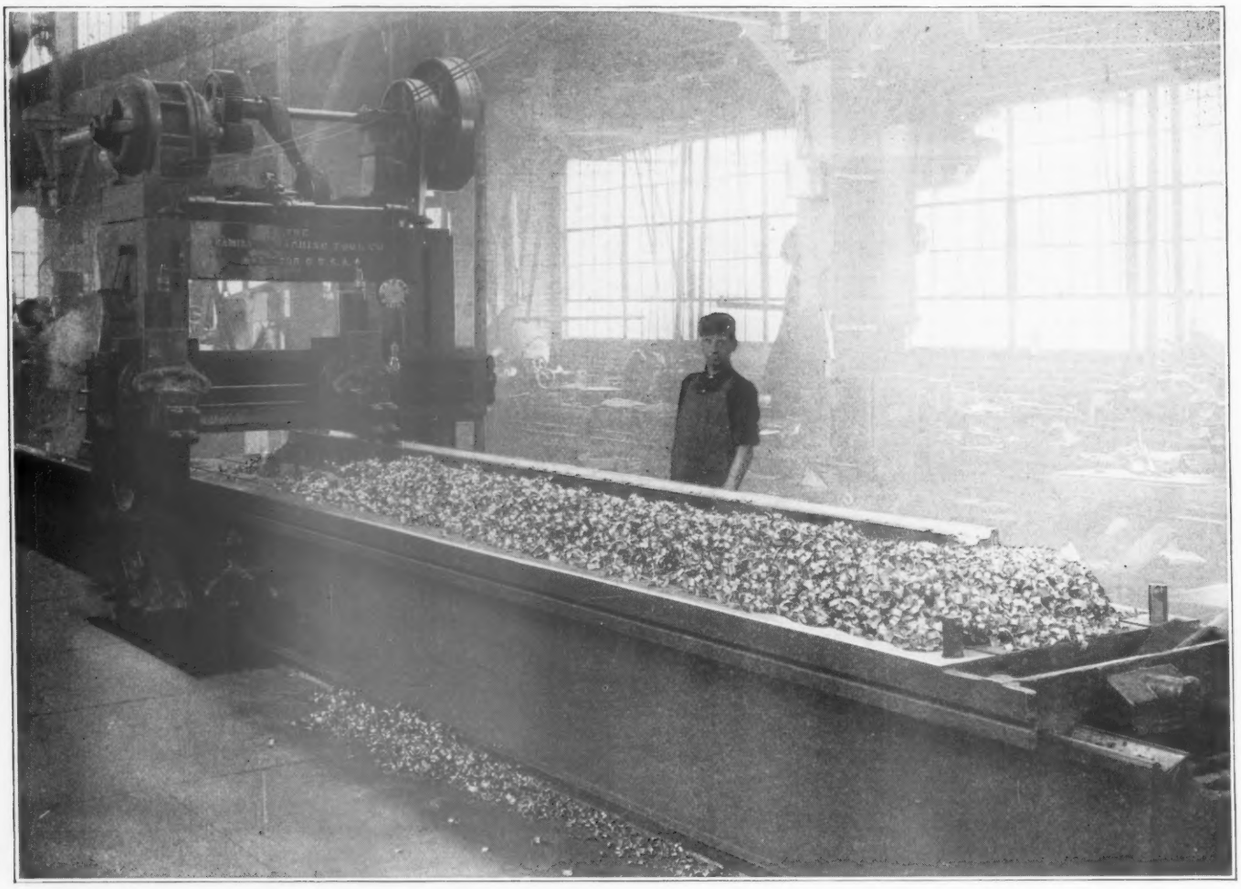
May we send our valuable and interesting booklet "Cutting Time Between Cuts"? A postal request will do.

Bridgeport, Conn.



BULLARD

N'S SERVICE



Here we have a HAMILTON Heavy Duty 48″ Planer, equipped with variable speed mechanism, planing link blocks for marine engines.

The photo shows the roughing cut being taken, removing ¾″ stock at 1/16″ feed; table speed 40 feet per minute.

These blocks are machined at the rate of 3.3 hours each, this being the time required for cutting out the recess as above and also finishing two sides.

This HAMILTON is one of many that is giving rapid production at low cost of upkeep and our agents will be glad to tell you about other satisfied users.

Get in touch with the one in your territory NOW. He is at your service.

Hamilton Machine Tool Co.

HAMILTON OHIO, U. S. A.

List of Agents:

Machineshop Equipment Co.....Boston, Mass.
Machine Tool Engineering Co.....New York, N. Y.
Syracuse Supply Co.....Rochester, N. Y. / Syracuse, N. Y. / Buffalo, N. Y.
Sherritt & Stoer Co.....Philadelphia, Pa.
Laughlin-Barney Mchy. Co.....Pittsburgh, Pa.
Wolverine Mchry. & Supply Co.....Detroit, Mich.
Cooperative Mchry. Co.....Cleveland, Ohio
Stocker-Rumely-Wachs Co.....Chicago, Ill.
Thomson Tool & Supply Co.....Indianapolis, Ind.
Wm. C. Johnson & Sons Mchry. Co.....St. Louis, Mo.
F. E. Satterlees Co.....Minneapolis, Minn.
Hendrie & Bolthoff Mfg. & Supply Co.....Denver, Colo.
Herberts Mchry. & Supply Co.....Los Angeles, Cal.
General Mchry. & Supply Co.....San Francisco, Cal.
M. J. Walsh Mchry. Co.....Milwaukee, Wis.
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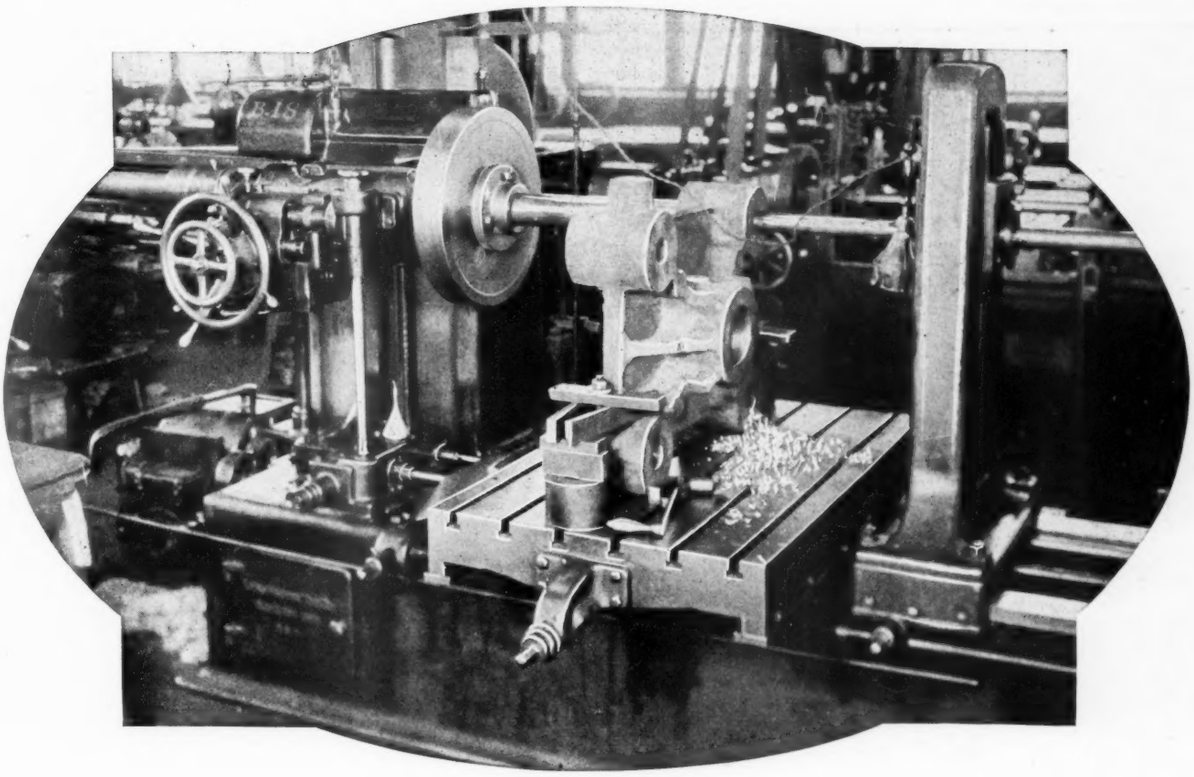
O. H. Van Horn & Co., Inc.....New Orleans, La.
H. W. Petrie, Ltd.....Toronto, Ont., Canada



The Logical Machine for "Odd Jobs"

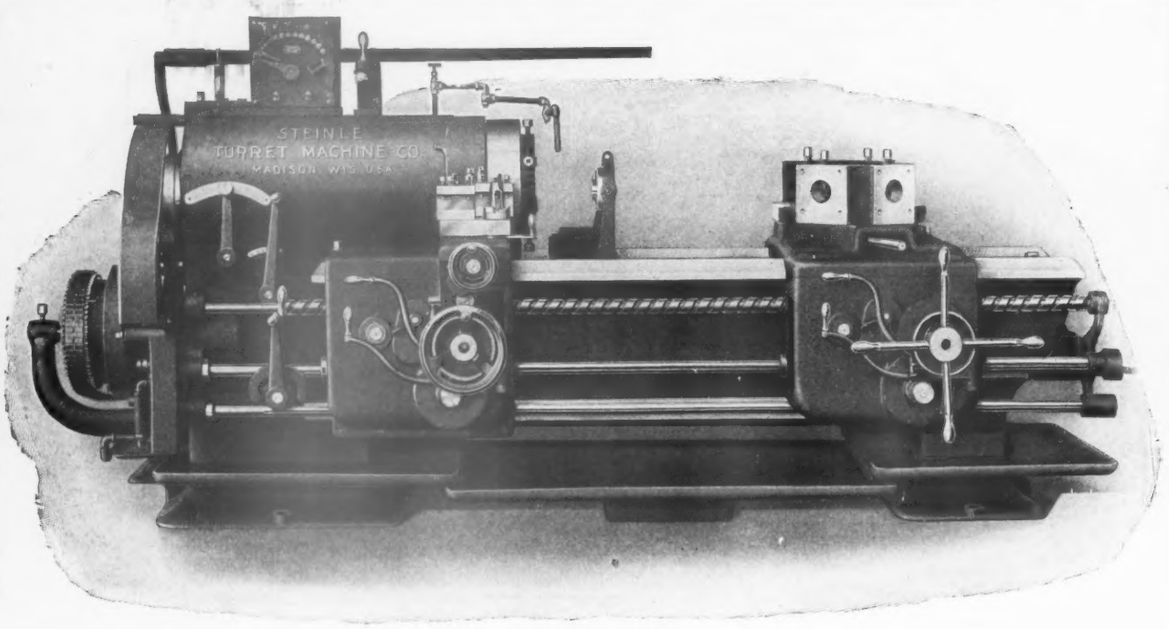
Every shop gets its share of those awkward "in between" jobs—big, cumbersome pieces that require several machinings and often severely tax the ordinary equipment. A characteristic example of work of this type is shown above. This piece—a masthead for a walking crane—required drilling, boring and facing in five places. The foreman wasn't long in deciding that the logical machine—the only machine in fact—for the job was his

Lucas "Precision" Milling, Boring and Drilling Machine

One setting was all that was necessary. The five holes were finished—all positively **parallel** in a fraction of the time necessary by other methods. There was no necessity to set up the piece several times on two or three machines. The quick power movements of the "Lucas" enabled quick adjustment from one position to another, and every machined surface was accurate in its relation to others. Not only was it a quicker job the "Lucas" way, but it was likewise a better one.

There are jobs by the score in your shops that could be handled on a "Lucas" at a substantial reduction in time, trouble and money. Put it up to us to **prove it.**

Lucas Machine Tool Co. Cleveland, O.



The Steinle 24" Full Swing Side Carriage Turret Lathe

THE Steinle 24" Full Swing Side Carriage Turret Lathe is not a war product, having been designed during peace times for industrial and railroad work.

It was found, however, to be admirably adapted to the rapid production of certain materials required for the prosecution of the War. For the past four years our efforts have been devoted exclusively to helping the United States and Allied Governments in winning the War by furnishing every Steinle we could possibly turn out for production of munitions. This machine has made and holds the record production time on many classes of such work.

It is now on a peace basis ready to undertake the making of new records in the production of many parts entering into the construction of locomotives.

Send us drawings of such parts as Wrist Pins, Knuckle Joint Pins, Valve Motion Pins, Brake Hanger Pins, Washers and Collars of the larger sizes, Air Pump Pistons, Rings and Heads, Piston Valves, Bull Rings and Followers, Small Size Pistons and Rings; or any other parts you may have to be made from either iron, steel, or malleable castings, bar stock or forgings. Our engineering department will gladly furnish production estimates on pieces shown on drawings furnished.

There are reasons why the Steinle 24" Full Swing Side Carriage Turret Lathe is ahead of all others in the economical and accurate production of many classes of work. We will give these reasons in future advertisements in this Journal. Watch for them. They will be interesting to you.

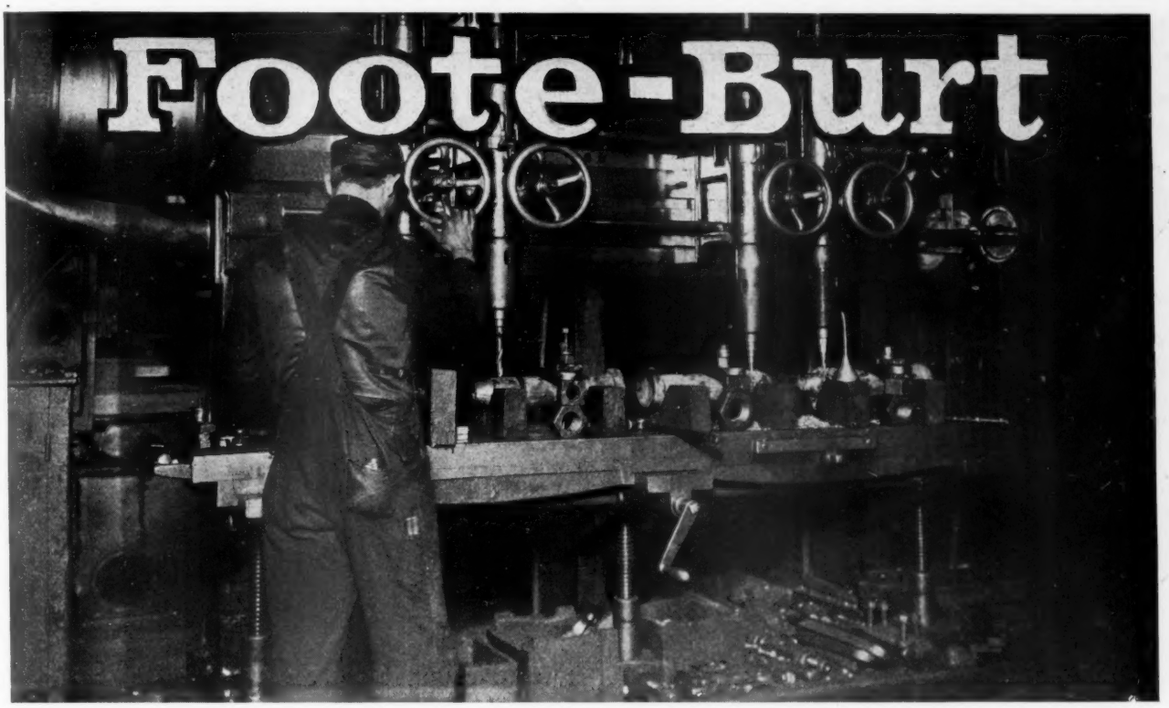
STEINLE TURRET MACHINE CO.

Madison **Wisconsin, U. S. A.**

Eastern Representative: Machine Tool Eng. Co., Singer Bldg., 149 Broadway, New York.

Detroit Representative: Cadillac Tool Co., Dodge-Power Bldg., 268 Jefferson Ave., Detroit, Mich.

Pacific Coast Representative: L. G. Henes, Monadnock Bldg., San Francisco, and Title Insurance Bldg., Los Angeles, Cal.



Four Times The Output

Whether It Be 3-4" Holes or 2" Holes

Here's a machine that answers the problem of more output per man unit—that will pave the way to big economies in your machine department.

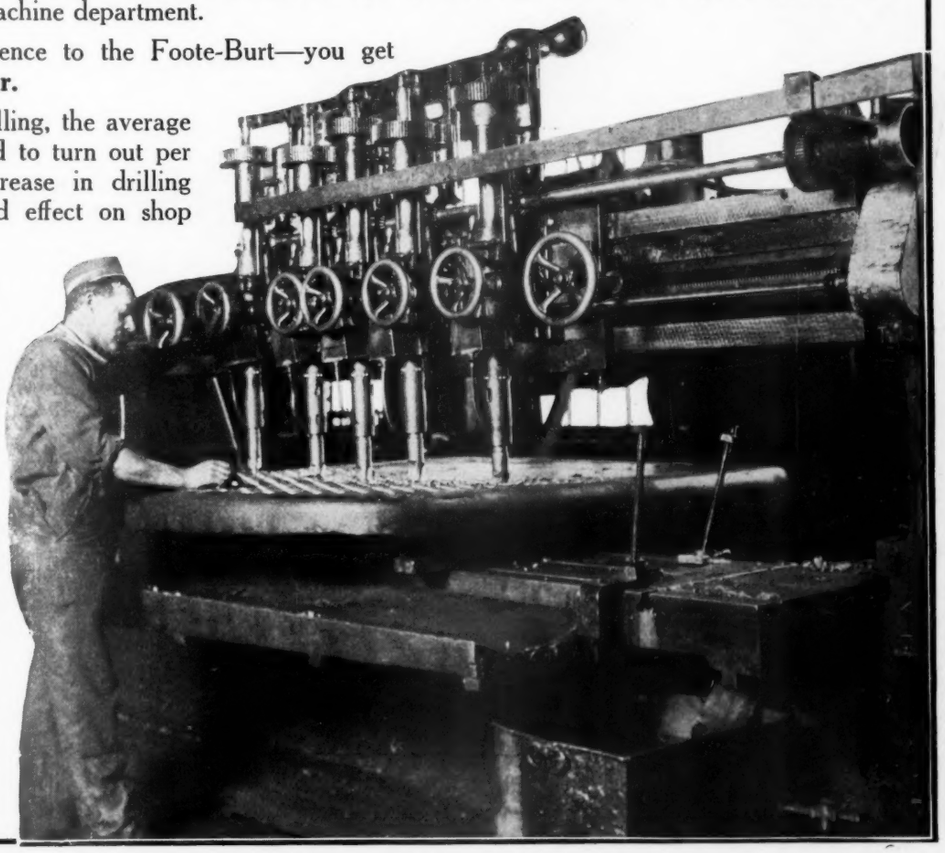
Range makes no difference to the Foote-Burt—you get output multiplied by **four.**

With the amount of drilling, the average railroad shop is required to turn out per day, even a slight increase in drilling efficiency has a decided effect on shop output.

The Foote-Burt four spindle drill takes up small shop space—it makes a big hole in your drill press work though.

Let's talk over your drilling problems.

We can show a decided profit the Foote-Burt way. Just ask us for circulars of independent Feed Drills.



The Foote-Burt Co.

Cleveland - Ohio

No. 204-A Angle Cutter Holder
No. 204-B Straight Cutter Holder
No. 203—Slide Tool
No. 210—Rear Tool Holder
No. 204—Multiple Turning Head
No. 206—Flanged Tool Holder
No. 206-D Adapter for Forged Cutter
2-B UNIVERSAL TURRET LATHE

The War Is Over

The Time of Keen Competition Is Here

It will therefore become increasingly necessary to watch your production costs.

The Foster 2-B Universal Turret Lathe equipped with the Foster Tools will bring your production costs down to a minimum.

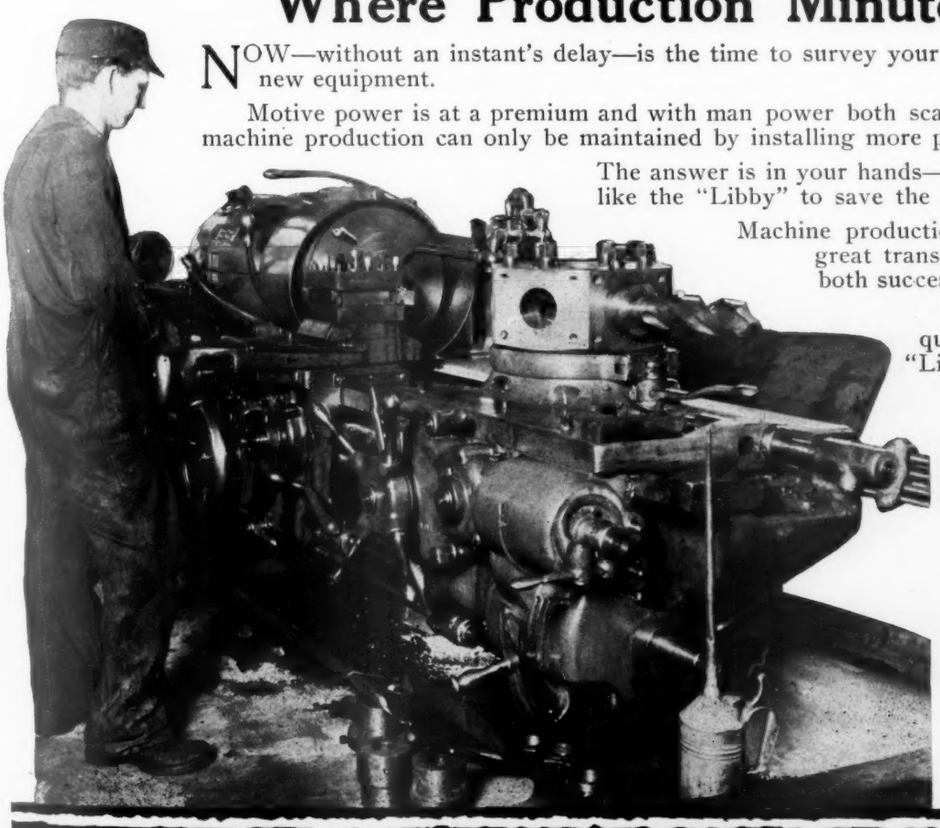
Our catalogue ought to be in your file. Write for it.

FOSTER MACHINE COMPANY, Elkhart Ind., U. S. A.

"Libby"

Heavy Duty Turret Lathe

Where Production Minutes Count



NOW—without an instant's delay—is the time to survey your shop facilities and plan on new equipment.

Motive power is at a premium and with man power both scarce and excessively high—machine production can only be maintained by installing more productive machinery.

The answer is in your hands—you must look to machines like the "Libby" to save the situation.

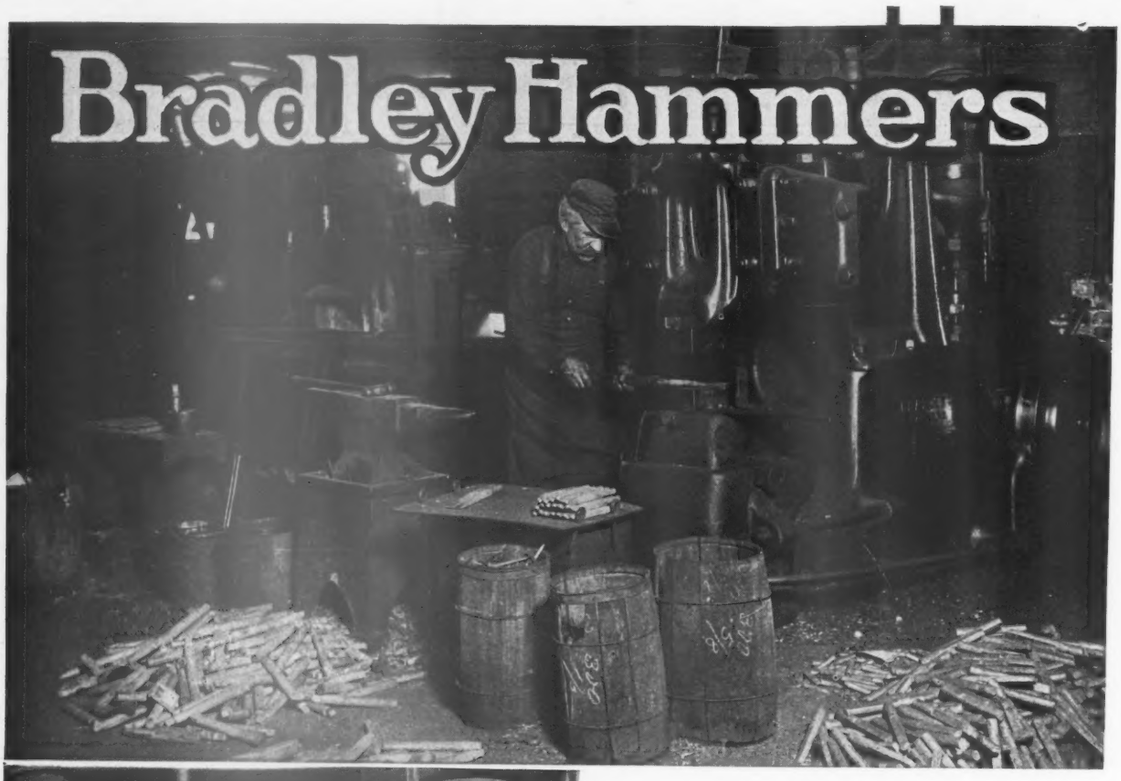
Machine production is a vital factor in our great transportation systems—it affects both successful operations and costs.

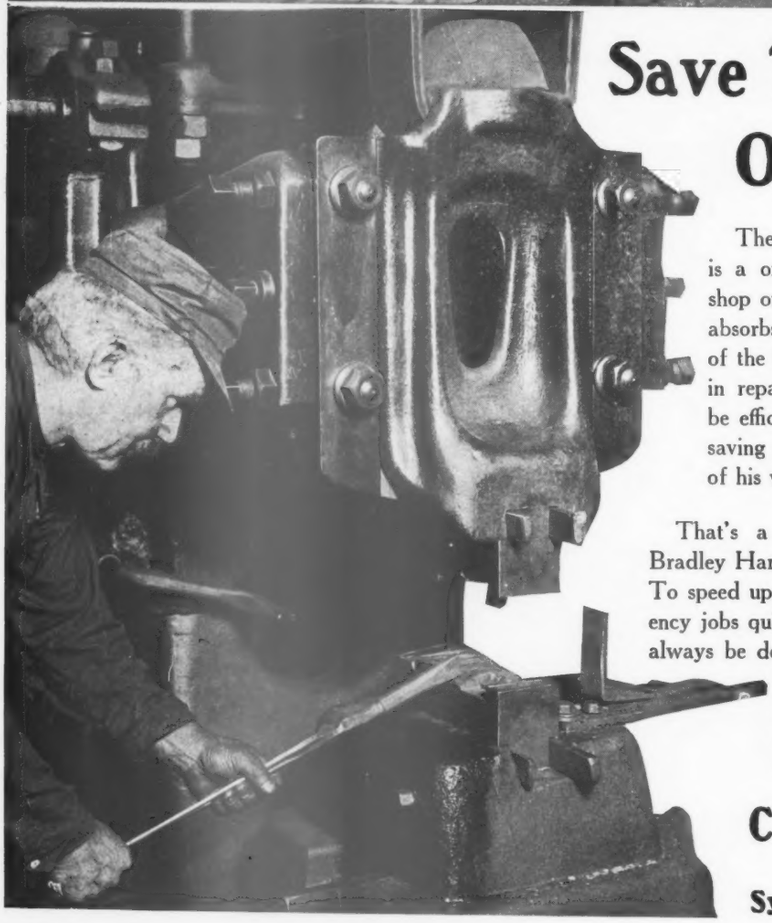
The solution to both these questions is found in the "Libby."

Let us quote you some actual Libby economies. It places you under no obligation.

International Machine Tool Co.
Indianapolis Indiana

Bradley Hammers





Save The Wages Of A Helper

The tool dressing fire in this busy shop is a one man job—it's the keynote to shop output too. The Bradley Hammer absorbs all the hard, back-breaking work of the helper. The Bradley keeps tools in repair so that locomotive output can be efficiently handled. Incidentally, the saving of a "helper" means the saving of his wages also.

That's a characteristic example of how Bradley Hammers save helpers in many shops. To speed up the rush jobs and get the emergency jobs quickly under way, the Bradley can always be depended upon.

There's many a job in your shop that's a typical "Bradley" job. Ask us for descriptive literature.

C. C. Bradley & Son
INC.

Syracuse New York

AJAX

TRADE MARK REG.

FORGING MACHINERY

Essential In War and Peace

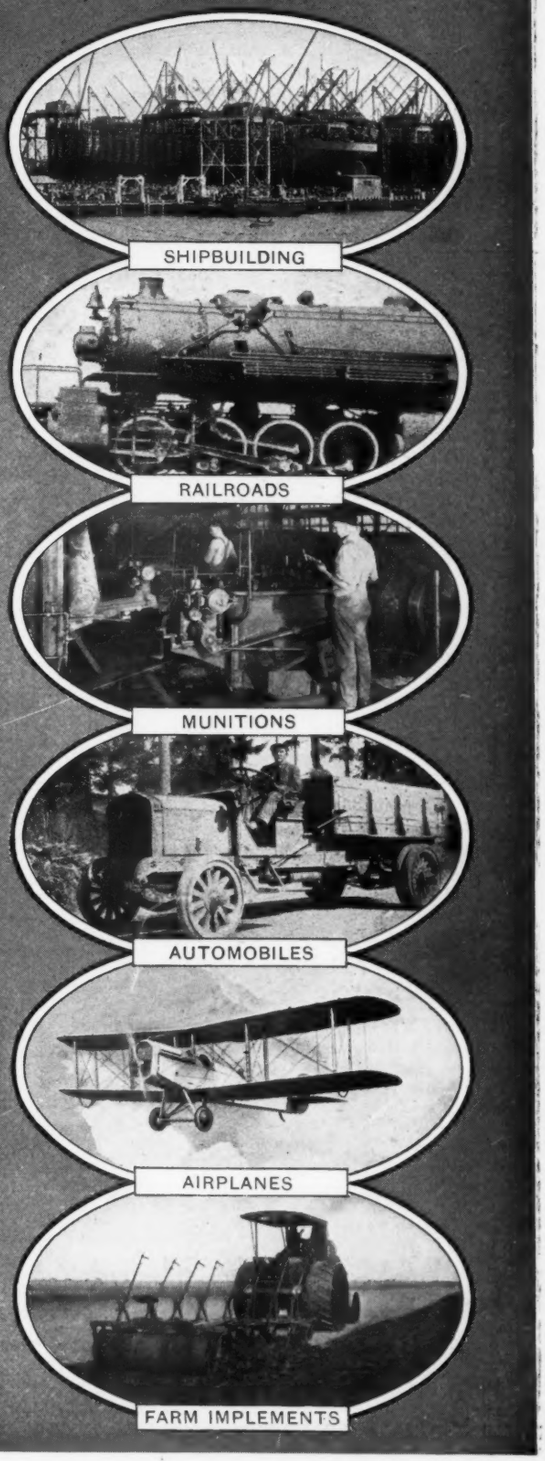
The war has proven beyond dispute that Ajax Forging Machinery is *essential* to the rapid and economical production of a wide range of iron and steel forging.

In every one of these vital war industries Ajax Forgings are playing indispensable parts.

Rivets and ship liners for our shipyards, forgings for our cars and locomotives, shells for our cannon, crankshafts for our war trucks, cylinders for our Liberty engines, bolts and nuts for our farm tools.

These are only a few of the things that Uncle Sam is depending on Ajax Machinery to produce.

Your plant will need the same advanced production methods in the battle for business men when peace is declared. Investigate the Ajax *now*.

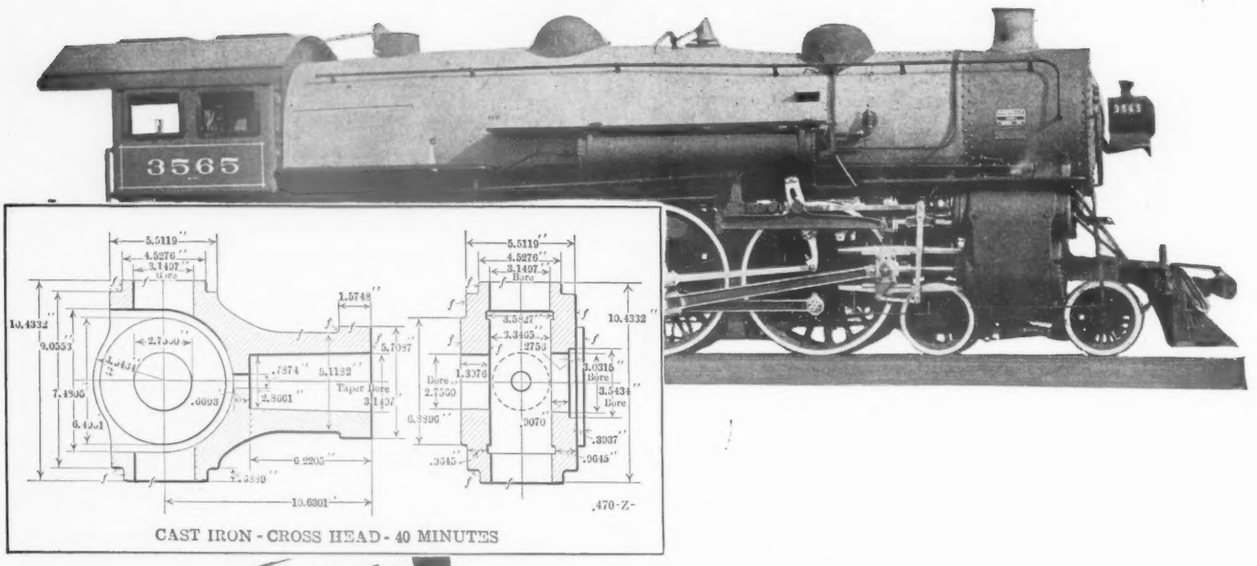


The Ajax Mfg. Co.

Cleveland, Ohio

621 Marquette Building
Chicago, Illinois

1369 Hudson Terminal
New York City



TIME TABLE
40 MINUTES

Piece shown above is a Cross Head.

Material, Cast Iron.

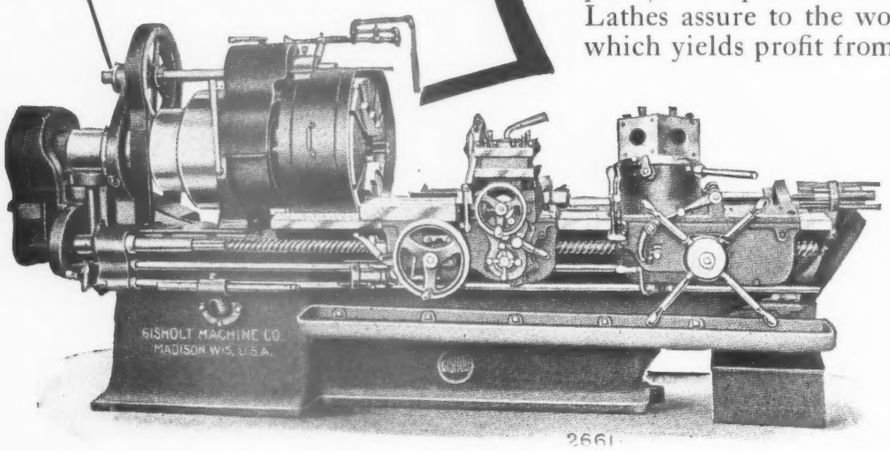
Production time, 40 minutes.

Finishing Locomotive Parts On Schedule Time

You can do it on the Gisholt Standard Turret Lathe and feel confident that your production will not be side-tracked.

Thousands of different parts owe their speed of production, accuracy and economy of manufacture to Gisholt concentration.

Whether it be locomotive parts, truck parts, electrical parts, automobile parts, machine tool parts, valve parts or what not, Gisholt Turret Lathes assure to the work in hand an ability which yields profit from your investment.



GISHOLT MACHINE COMPANY

Builders of Standard and Automatic Turret Lathes, Vertical or Horizontal Boring Mills, Small Tool Grinders, Tools, Special Machinery.

This Man's Time is Reported Correctly

His Production is Greater
His Time is Accurate
His Work is Easier Planned

The Periodograph Does It

Accurate records of the time spent on each operation are essential to proper management of a factory. They are necessary to assure maximum production.

Why record painstakingly the time of arrival and departure of employees and then figure your costs on mere guessing as to how the time was spent?

Relieve your productive workers of the burden of time-keeping—make them 100% producers.

The Periodograph will record their time correctly and quickly. No hunting for a pencil to write out time slips—no guessing at the time spent—no forgetting to report the time on short jobs.

Let the Periodograph record the time with mechanical accuracy. Periodograph records *mean something* to the management because they show facts. They simplify shop routine and put a business-like snap into it. Let us tell you the full story. Write for interesting booklet entitled "Better Factory Control."

GISHOLT MACHINE COMPANY

1162 East Washington Ave., Madison, Wis., U. S. A.

Builders of Standard and Automatic Turret Lathes, Vertical and Horizontal Boring Mills, Tool Grinders, Small Tools, Special Machinery, etc.

Eastern Sales Office: **30 Church Street, New York**

Works: **Madison, Wis.; Warren, Pa.**

Norton Grinding Solved This Problem

GRINDING superheater damper shafts was not a new "stunt" in this busy shop. The damper shaft was only a small item on a locomotive, but it was an important feature to successful locomotive operation. The turned shaft was not meeting service demands. Assigning this work to the Norton Grinding Machine, production was increased, finish and accuracy were improved and better locomotive performance resulted.

The finished shaft is 1-inch diameter by 13½ inches long and the "Norton" easily completes 70 shafts a day.

Grinding wrist pins, knuckle pins, brake hanger pins and motion work pins is handled by this machine also.

Grinding the bearing of various locomotive parts is the solution to better locomotive performance. A ground bearing means a true bearing — a bearing ready to render service from the moment of installation. This eliminates the necessity of "breaking in"—the uncertainty of running hot, and other features which make up a large percentage of locomotive failures.

Our Service Department is at your call and also the benefit of our valuable experience.

Norton Grinding Co.
Worcester Mass.

Notes on Grinding
NORTON COMPANY, WORCESTER, MASS.
No. 14

WHY IT PAYS TO KEEP THE MACHINE IN GOOD CONDITION

Economy cannot be expected if the machines are light and shaky, or if the foundations are not solid. A grinding wheel that vibrates or jumps from any of these causes is soon pounded to pieces by the percussion set up by the castings on the face of the wheel.

A test conducted by an extensive user of grinding wheels for the purpose of determining whether or not it pays to install concrete foundations under the grinding machines is of interest. The wheels used were identical as to size, grain and grade, and the same machines and castings were employed. One set of machines was mounted on concrete or solid foundations and the other on wood or shaky foundations. The results were as follows:

Average life of wheels on wood floor, days 113

Average life of wheels on concrete floor, days 188

Increase in life due to solid foundation, per cent 65

Average saving a month per wheel on concrete floor $2.00

Average yearly saving per wheel $24.00

When many wheels are used, this saving is decidedly an important consideration. In this case, the concrete foundation paid for itself inside of two months and the saving in wheels will go on indefinitely amounting to several hundred dollars annually.

Loose and insecure mooring is also detrimental to the life of the grinding wheel. Don't wait until the machine begins walking around the foundry floor before remedying matters.

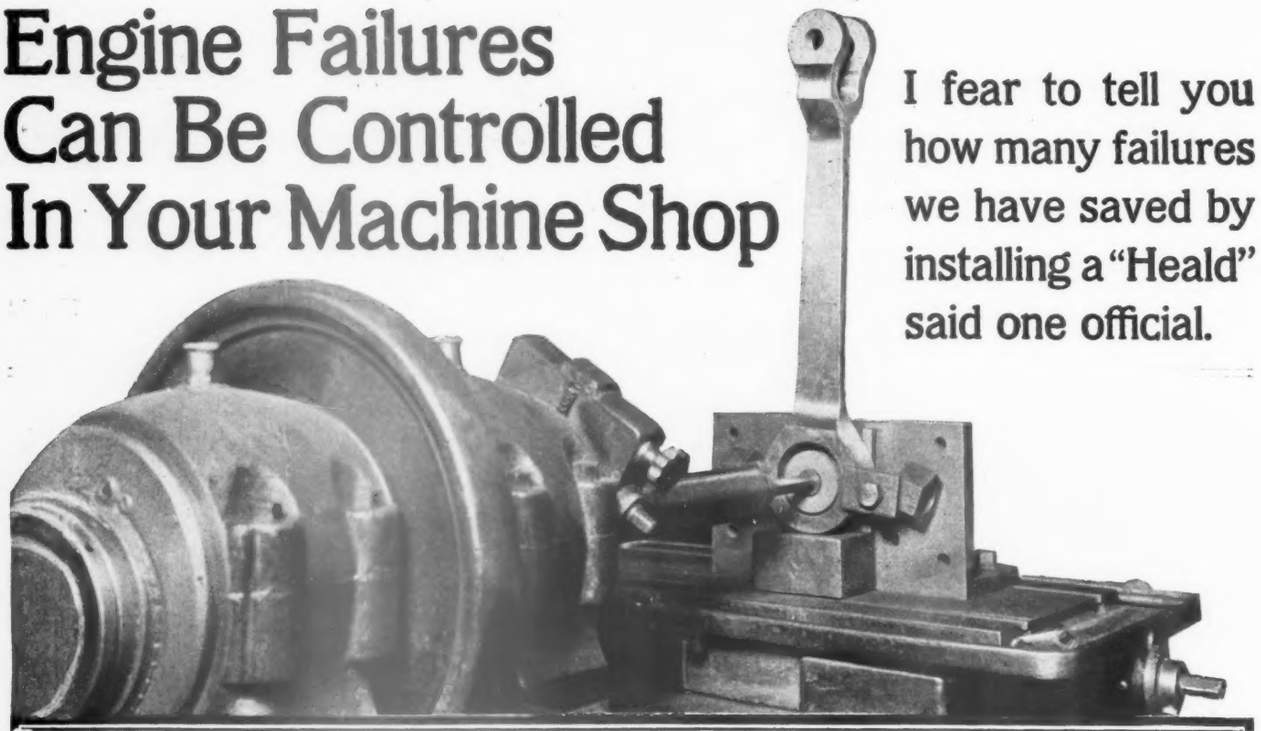
Similar figures could be produced to show the saving effected by keeping bearings in good condition. Excessive radial play and end play destroy the wheel rapidly. Many times complaints received to the effect that grinding wheels are not standing up as they formerly did, can be traced directly to bearing troubles. The introduction of harder grades, as for example, from grade S to grade U, only partially remedies matters because the speed of cutting is sacrificed and the operator has to put forth greater effort to do the same amount of work.

NORTON COMPANY

ELECTRIC FURNACE PLANTS
NIAGARA FALLS, N. Y. CHIPPAWA, ONT.
NEW YORK STORE 151 CHAMBERS ST.
CHICAGO STORE 11 NO. JEFFERSON ST.
TRADE NORTON MARK

Engine Failures Can Be Controlled In Your Machine Shop

I fear to tell you how many failures we have saved by installing a "Heald" said one official.

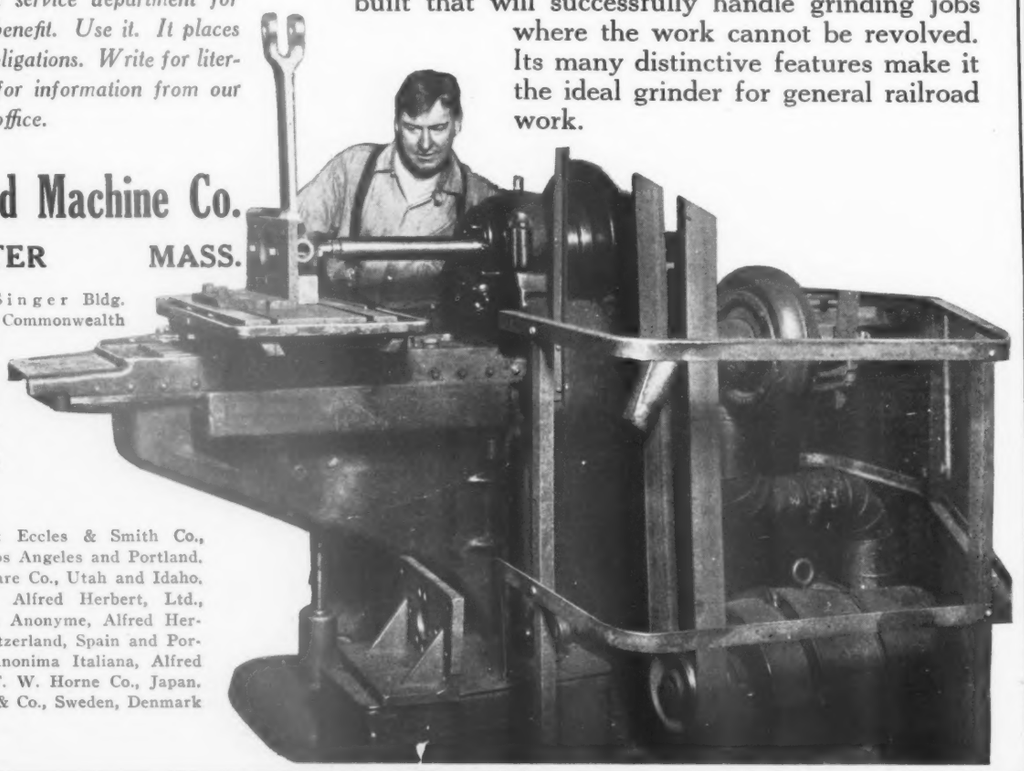


Where machine shop practices are reflected in better locomotive performance, is in the grinding of motion work bushings. The old-fashioned method of "lapping" a bushing with a lead lap is both uncertain and costly. The lead lap will not give a true hole.

Grinding insures a finished hole—straight and positively round. This feature provides a better pin bearing which in turn results in longer service between shoppings—results in service noticeable for its freedom from breakdowns or failure.

We maintain a service department for your exclusive benefit. Use it. It places you under no obligations. Write for literature and ask for information from our nearest branch office.

The Heald No. 60 Grinder is the only machine built that will successfully handle grinding jobs where the work cannot be revolved. Its many distinctive features make it the ideal grinder for general railroad work.

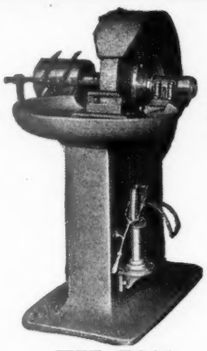


The Heald Machine Co.

WORCESTER MASS.

New York, 839 Singer Bldg. Philadelphia, 1408 Commonwealth Bldg. Chicago, 24 So. Jefferson St. Detroit, 911 Majestic Bldg. Cincinnati, 311 Provident Bank Bldg. Cleveland, 1102 Swetland Bldg.

Western Agents: Eccles & Smith Co., San Francisco, Los Angeles and Portland. Salt Lake Hardware Co., Utah and Idaho. Foreign Agents: Alfred Herbert, Ltd., England. Societe Anonyme, Alfred Herbert, France, Switzerland, Spain and Portugal. Societa Anonima Italiana, Alfred Herbert, Italy. F. W. Horne Co., Japan. Wilh. Sonnesson & Co., Sweden, Denmark and Norway.



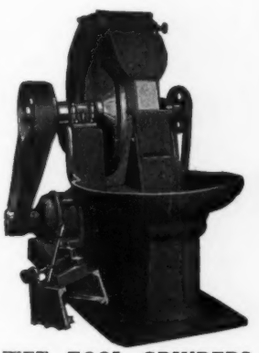
"Bridgeport" Grinders

Is grinding time lost time in your shop? It was in many shops before a Bridgeport was installed.

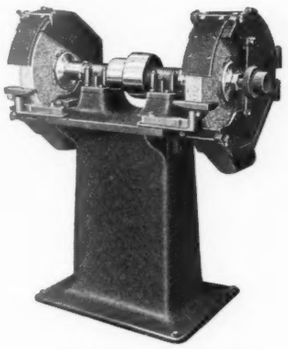
WET TOOL GRINDERS
Belt driven. Six sizes. Wheels 14" to 42" diameter.

One of the shrewdest mechanical officials in the railroad field today recently said:

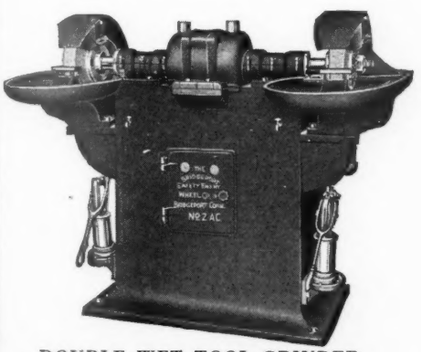
"It is increasingly evident that grinding has become an important production factor in railroad shops. The man who studies advanced shop methods will unfailingly arrive at this conclusion. I know of many shops where 'Grinding time is lost time.' These shops are fully equipped with up-to-date machine tools and other facilities. Bridgeport Floor Grinders installed in these shops would exert a powerful influence on increased output."



WET TOOL GRINDERS
Motor driven. Five sizes. Wheels 20" to 42" diameter. Made with low bowl for railroad shops, or high bowl if desired.



FLOOR GRINDERS
Belt or motor driven. Thirteen sizes.

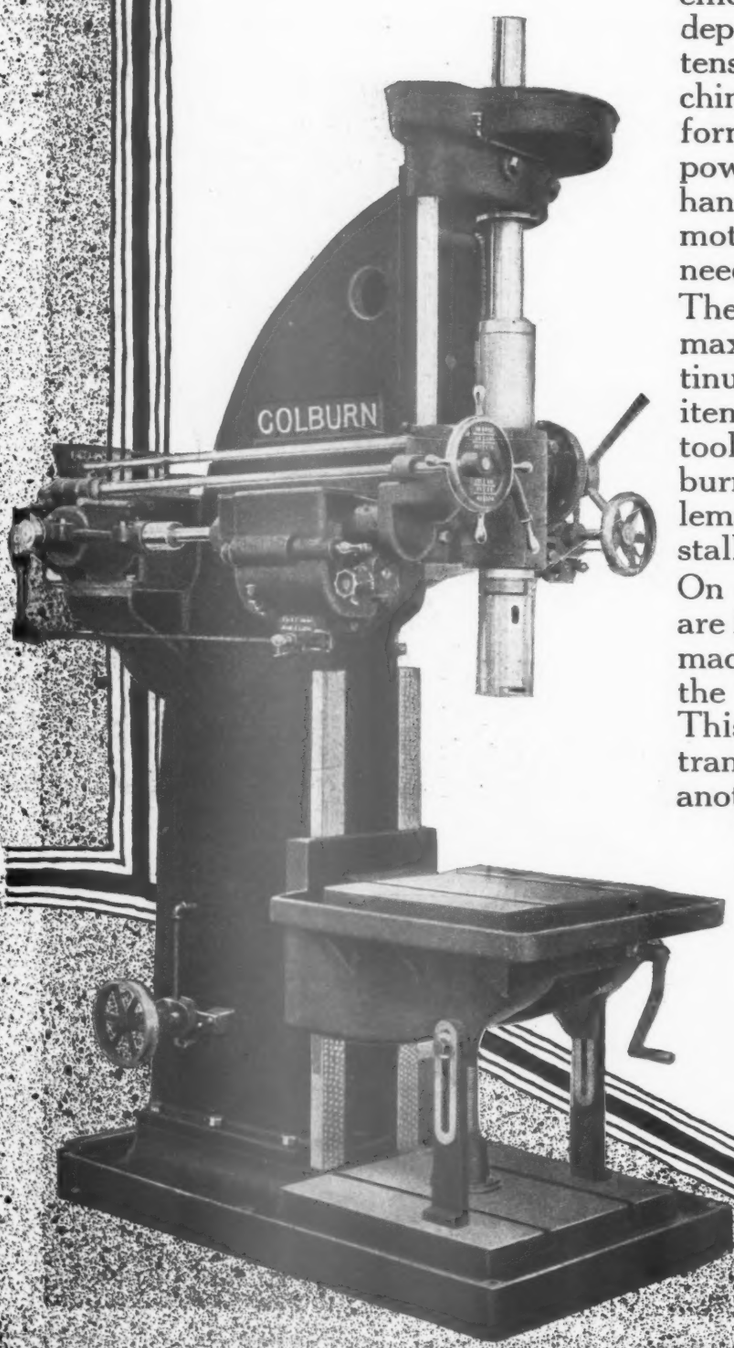


DOUBLE WET TOOL GRINDER
Direct or alternating current. Motor or belt driven. Wheels 16" to 26" diameter.

If grinding time is lost time in your shop, you can ill afford to wait longer in the matter of grinders.

WET AND DRY GRINDER
Wet and Dry Grinders. Three sizes. Motor or belt driven. Used in roundhouses and shops where space is limited.

Meeting Your Overload-



NEARLY every machine shop is facing an overload right now. How efficiently this overload will be handled depends upon two factors—the intensity of the Winter, and your machine tool equipment. Over the former, no one has any controlling power—the latter is strictly in your hands, if you guard important locomotive operation by installing much needed tools.

The conservation of man power—maximum output per man unit—continuous and rapid production—are all items traceable directly to machine tool equipment. How well the "Colburn" line will help solve your problems is reflected in many railroad installations.

On one busy railroad, oil cups which are forged solid on the rods, are drilled, machined and tapped at one setting on the "Colburn" heavy duty drill press. This eliminates the time and labor to transfer the piece from one machine to another—saves the time ordinarily taken for another "set up"—delivers a finished job in the minimum of time—saves additional machine tool installations.

COLB

MACHINE

Franklin,

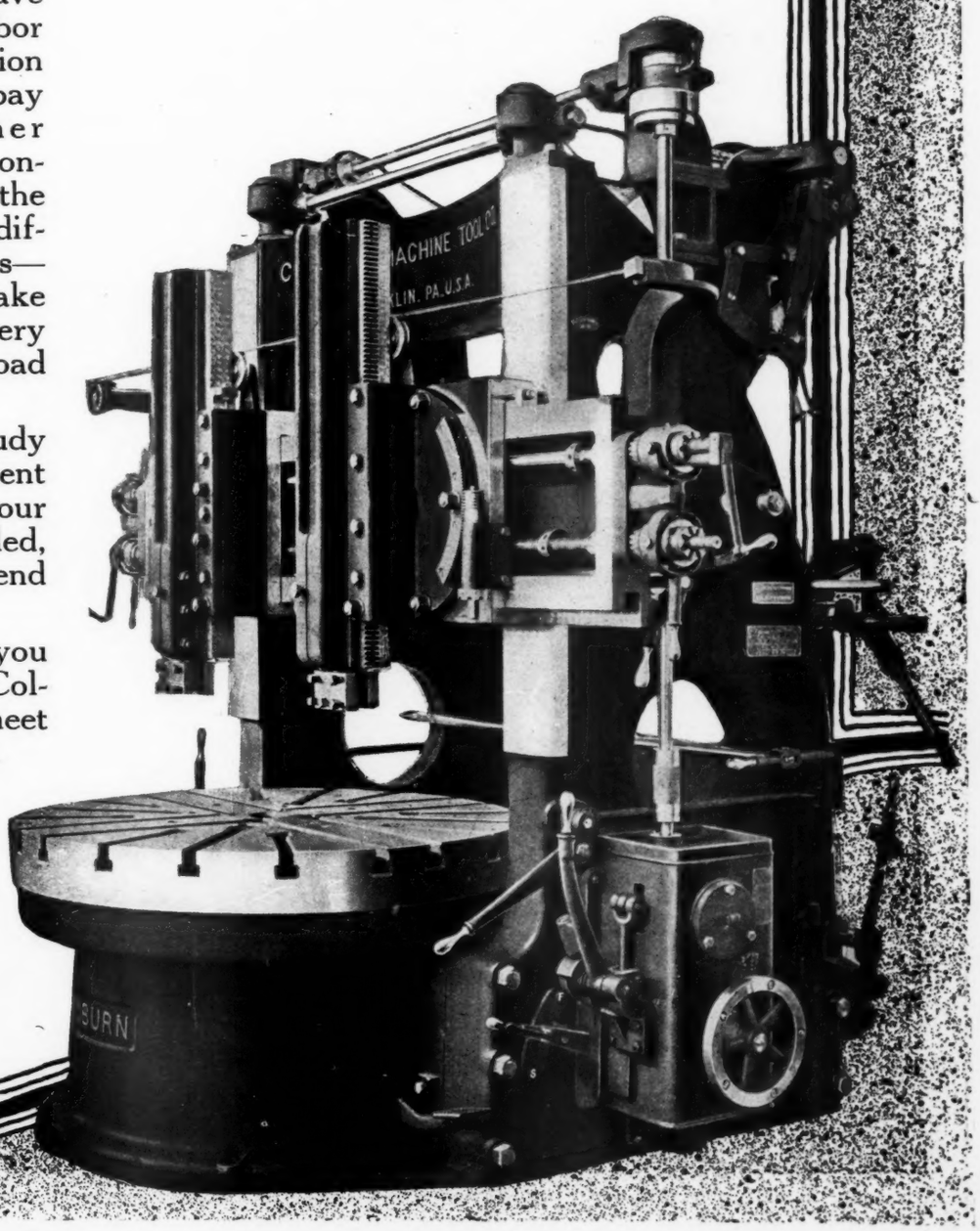
Reducing Your Overhead

RIGHT now, in the face of ever increasing material and labor cost, you will find the "Colburn" Heavy Duty Drill Presses and Vertical Boring and Turning Mills will help maintain output—will insure reliable and dependable production in your shop.

"Colburn" tools have many distinctive labor saving and production features which pay dividends whether your work be continuous output or the handling of many different kinds of jobs—jobs which go to make up the average, every day run of railroad work.

We want you to study Colburn equipment point by point; our catalog gladly mailed, or if you prefer send us blue prints.

We'll gladly tell you just how the "Colburn" line will meet your requirements.



BURN
TOOL CO.
Penna.

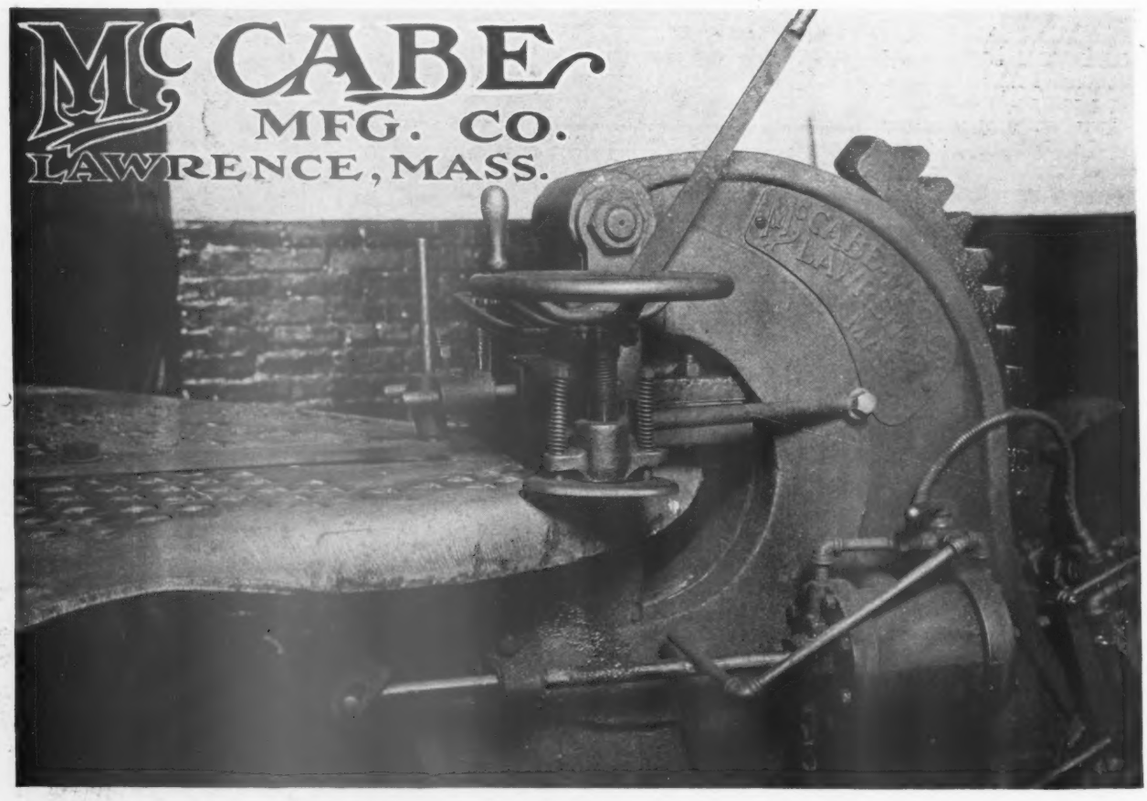
The McCabe Flanged This Corner

FLANGING flue sheet corners is a simple matter with the McCabe Pneumatic Flanging Machine. Note how the guide is bolted to the sheet—how the sheet is then moved in a true radius. This arrangement insures the flanging of a better fitting corner—the finished corner is a true radius.

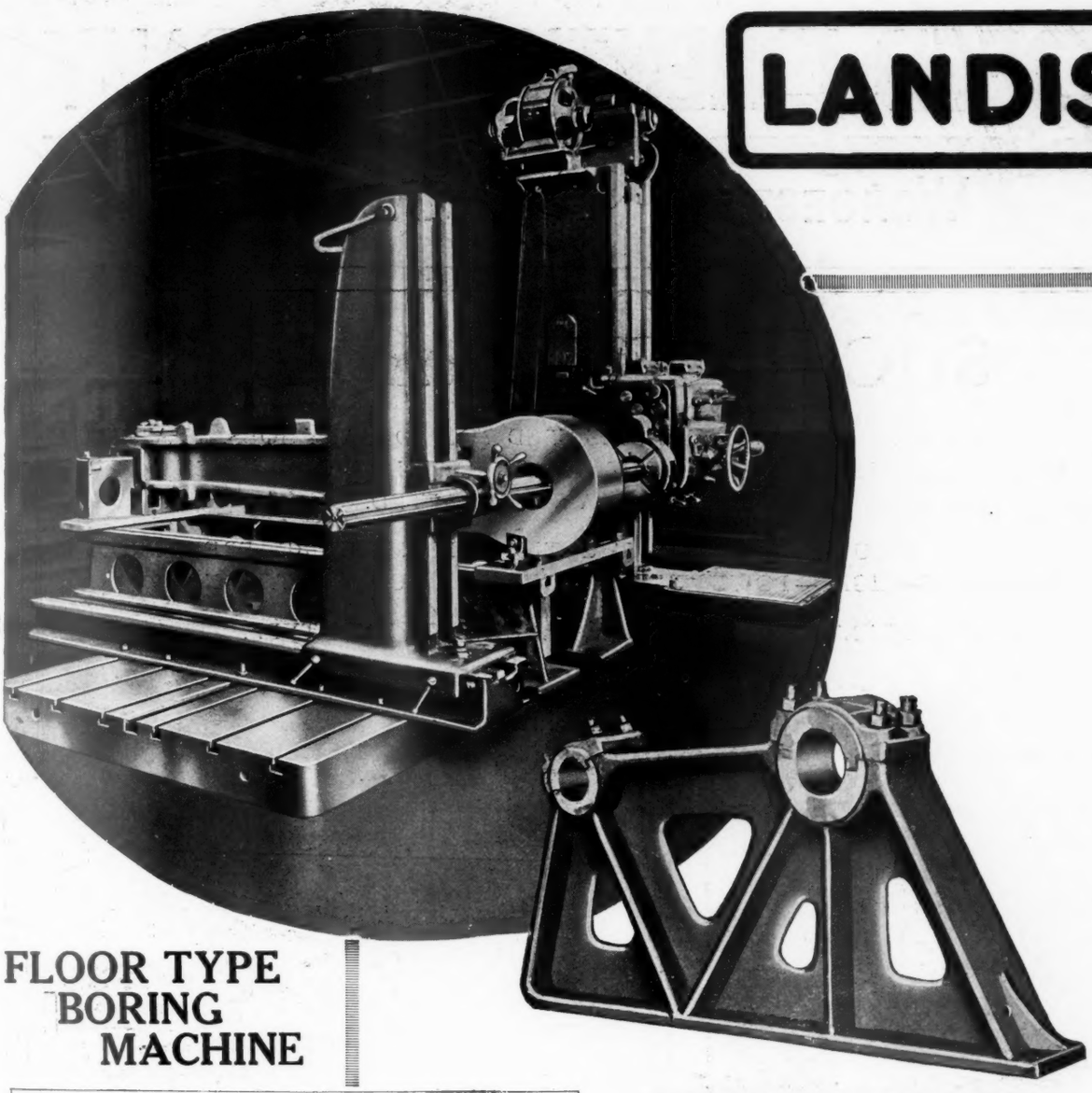
The McCabe mechanically insures perfect fits—it eliminates guess work.

The McCabe absorbs all the hard back-breaking work of hand flanging and requires but two operators—McCabe saves time and man power on every piece flanged.

Send us sketches or blue prints and we will gladly tell you how quickly the McCabe will handle your work. Write today.



LANDIS



FLOOR TYPE BORING MACHINE

EMC

THE ELYRIA MACHINE COMPANY
ENGINEERS AND MACHINISTS

ELYRIA, OHIO
October 1, 1918.

The Landis Tool Co.,
Waynesboro, Penna.

Gentlemen:

After six months of operation of your No. 35 Horizontal Boring Mill, we desire to express our entire satisfaction with the machine.

We have used this machine for a considerable range of work, having put through Lathes of different sizes, from 22" to 42", and we have always had the best results on this wide range of work.

The operator expresses his satisfaction with the ease of manipulation of the control levers on the gear box.

We beg to remain,

Very truly yours,
THE ELYRIA MACHINE COMPANY.
R. J. Whelan
Pres. & Gen'l. Mgr.

RJW:HK

SATISFACTORY RESULTS

"We desire to express our entire satisfaction"—"the operator expresses his satisfaction"—these are the comments which invariably follow the installation of the Landis Boring Machine. This kind of satisfaction is bound to result in the use of a machine so carefully designed and so thoroughly well made as the Landis.

Let us show you how the many improved design features of the Landis can hasten your production and economize labor, time and floor space.

Immediate Delivery

LANDIS TOOL COMPANY
Waynesboro, Pa. New York Office: 50 Church St.

REED-PRENTICE COMPANY

WORCESTER MASS. U.S.A.

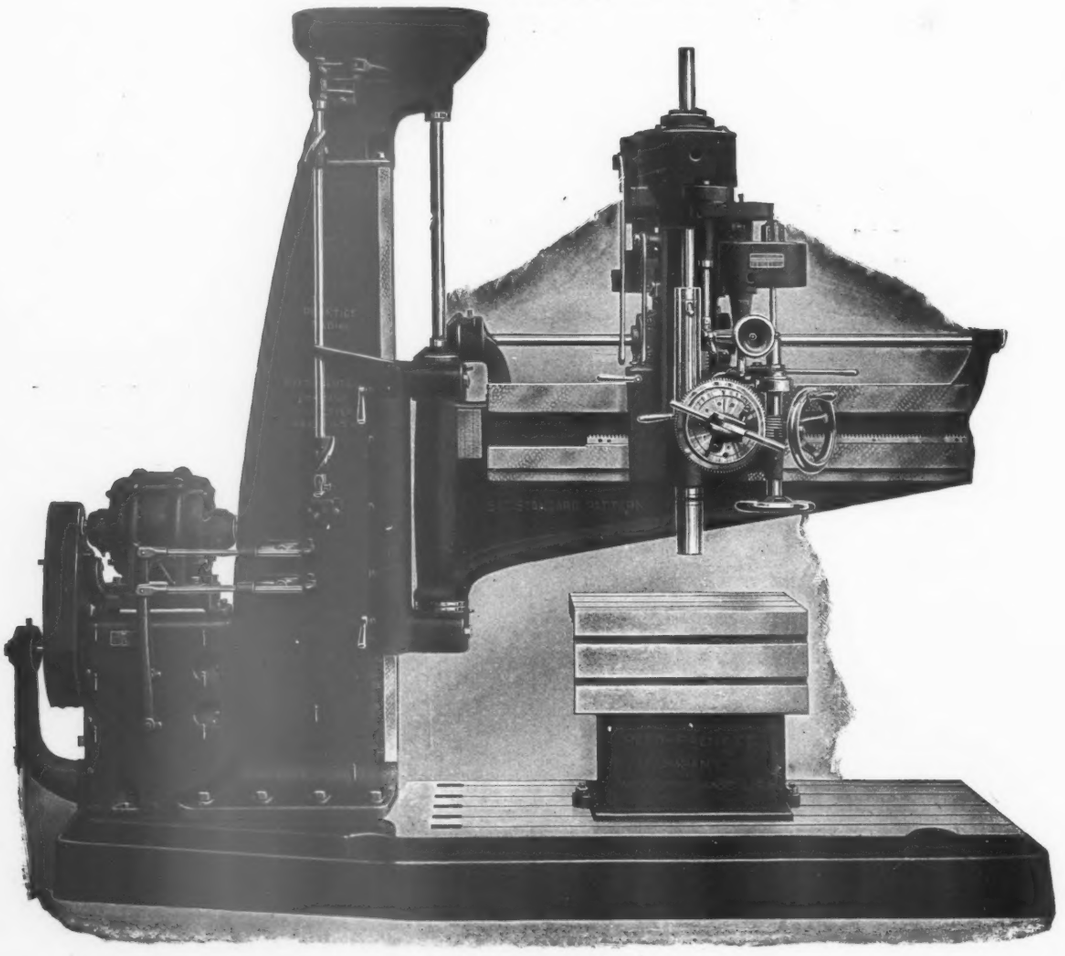
SUCCESSFUL RADIALS.

A RADIAL DRILLING MACHINE IS USED FOR SO MANY JOBS, THAT TO BE REALLY SUCCESSFUL, IT MUST BE UNIVERSALLY CONVENIENT FOR ALL OPERATIONS TO WHICH IT CAN BE ADAPTED.

THROUGHOUT ALL THESE VARIATIONS IT MUST BE FREE FROM VIBRATION—RIGID—POWERFUL—AND WITHOUT COMPLICATION.

A REED-PRENTICE RADIAL IS A MACHINE OF THIS TYPE.

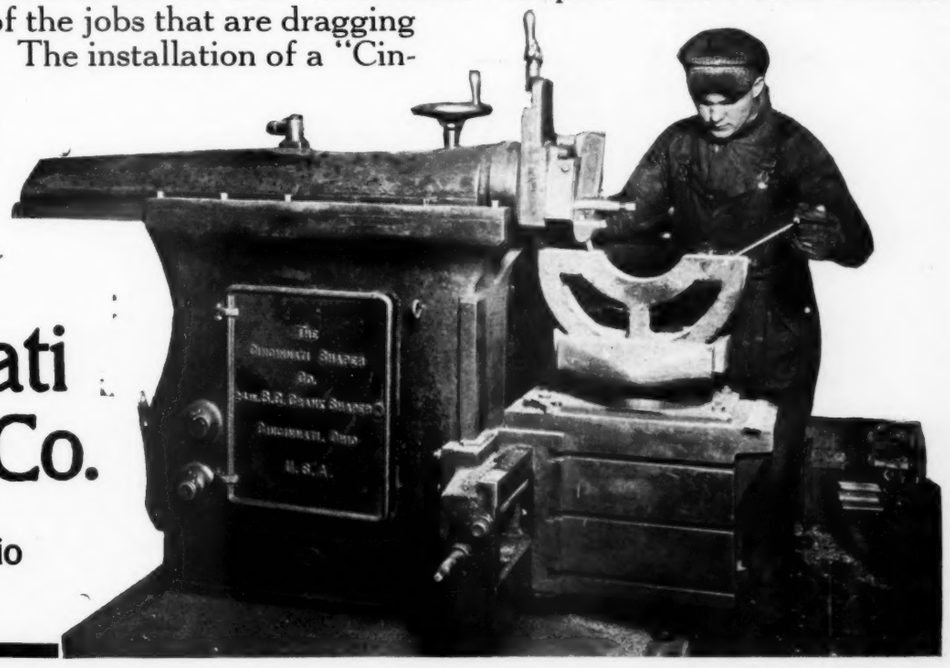
MANNING, MAXWELL & MOORE, INC.
FENWICK FRERES
CANADIAN FAIRBANKS-MORSE CO., LTD.



The Boy Problem Solved by a Cincinnati Shaper

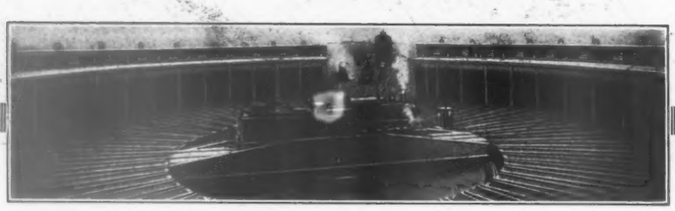
YOU can turn the "pep" and enthusiasm of youth into real productive labor by assigning your boys to the "Cincinnati" shaper. Here is a machine so simple that even a boy of slight experience can operate it to advantage. A machine, powerful to pull heavy cuts or take a neat finishing cut; a machine with speed and feed changes located at the most efficient points.

There are many "short run" jobs about your shop that are typical shaper jobs. Production figures whether based on single pieces or on jobs in quantity, will be a surprise to you when based on the "Cincinnati" shaper. Better look around your shop for some of the jobs that are dragging behind your output. The installation of a "Cincinnati" will greatly help output and reduce expensive machine time.



The Cincinnati Shaper Co.

Cincinnati, Ohio

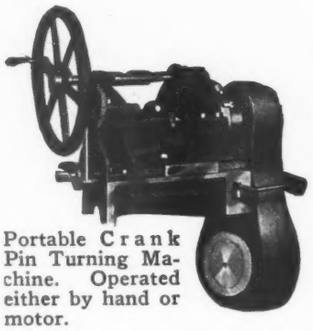


PUT YOUR EMERGENCY REPAIRS ON A PAYING BASIS

Rotary Flue Cleaning Machine. Removes all scale at the rate of 8-10 ft. per minute. Capacity 1½ in. to 3 in. flues; also 3 in. to 6 in.

It's the ordinary, regular line of roundhouse jobs that cost money—that causes the unnecessary tying up of power unless you have labor saving portable tools. Many such tools specially designed for time saving operations have been standardized by

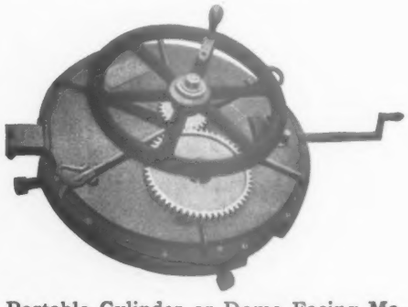
H. B. Underwood Corporation



Portable Crank Pin Turning Machine. Operated either by hand or motor.

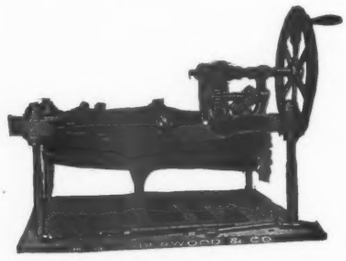
When removing part set of flues in the roundhouse, the number is generally so small that they do not receive the proper rattling. With the Underwood Rotary Cleaner, you can clean one or an entire set quickly.

Scored crank pins are quickly trued up with the Underwood Portable Crank Pin Truing Machine. Not only quicker but also more reliable than hand filing. Not necessary to drop the wheel, which saves much valuable time and costly delay to power.



Portable Cylinder or Dome Facing Machine. Operated either by hand or motor.

The Underwood Portable or Dome facing machine has many uses in the average day's run of roundhouse jobs. Leaky cylinder head joints quickly faced true, thus eliminating costly and dangerous steam leaks.



Portable Valve Seat Rotary Planing Machine. Operated either by hand or motor.

Roundhouse tool equipment is not complete without this handy tool. Light and compact, this tool can be easily taken from job to job and soon proves its value.

If we haven't a regular "Underwood" portable tool to meet your needs, write us. We are always ready to figure on and build any special line of tools.

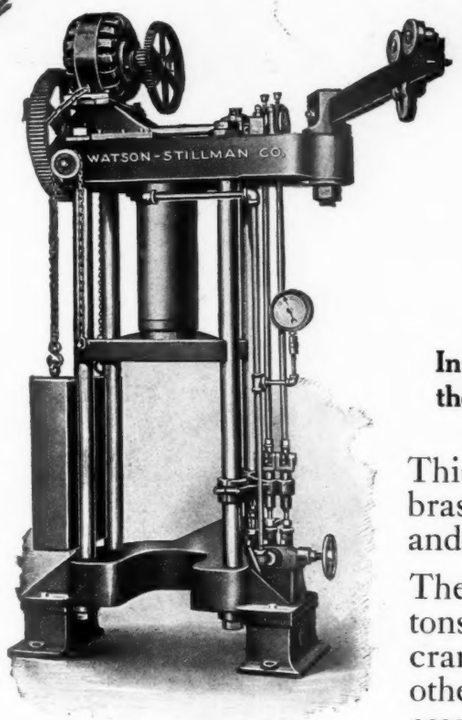
H. B. Underwood Corporation

Philadelphia **Pennsylvania**

HYDRAULIC MACHINERY

For Locomotive, Car and Railroad Repair Shops

In developing these machines, we have kept in mind the latest requirements of car and locomotive shops.



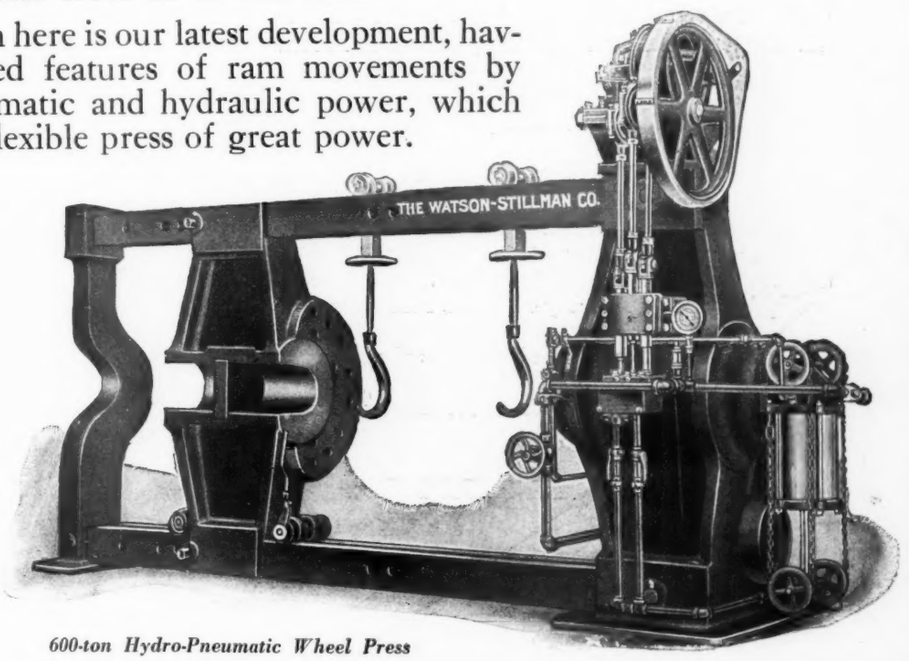
100-ton Hydraulic Forcing Press

This press was designed to force driving box brasses, bushings, etc. It is powerful and rigid and is especially designed for high production.

These presses are built in standard sizes up to 150 tons, either belt or motor driven. The overhead crane assists in handling heavy pieces. We build other presses for crank pin forcing, armature assembling, etc.

We build wheel presses in several types—hand power, belt power or electric drive, in capacities from 15 to 600 tons.

The press shown here is our latest development, having our patented features of ram movements by combined pneumatic and hydraulic power, which makes a rapid flexible press of great power.



600-ton Hydro-Pneumatic Wheel Press

Write for catalogues of pumps, accumulators, rail benders, axle straighteners, jacks, pit jacks, shears, forcing presses, etc.

The Watson-Stillman Co.

188 Fulton St. NEW YORK

Engineers and Builders of Hydraulic Machinery

CHICAGO—McCormick Building

366

The Specifications Call For .0001±

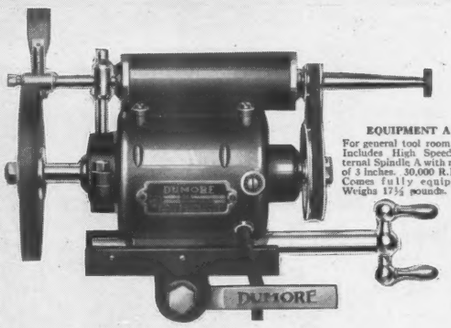
SUPPOSE you were studying the specifications for a big job—one that called for making new and expensive tools—would your present tool-room equipment let you handle it? There are only two kinds of tools—the good and the poor—there's no half-way mark. And the quality of your output is fixed by the degree of accuracy you can obtain in your tool-room.

Accuracy in grinding depends upon correct cutting speed and perfect running balance. That is why the **DUMORE** grinder has been given speeds ranging from 10,000 to 50,000 R. P. M., along with a dynamically balanced armature. With this tool in your shops you can eliminate chatter, taper or bell-mouthed grinding. Then, too, the **DUMORE** is portable, easily carried to all parts of the shop and quickly set up in any machine ready for use.

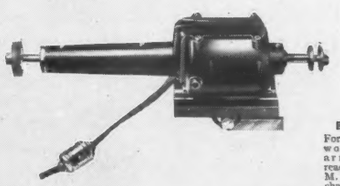
If you are interested in obtaining only the best tools, ask your dealer about the **DUMORE** grinder. If he doesn't carry it, write us for literature and prices.

WISCONSIN ELECTRIC CO.

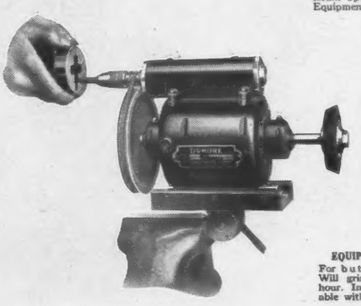
3706 16th St. **RACINE, WIS.**



EQUIPMENT A
For general tool room use. Includes High Speed Internal Spindle A with reach of 3 inches. 30,000 R.P.M. Comes fully equipped. Weighs 17½ pounds.



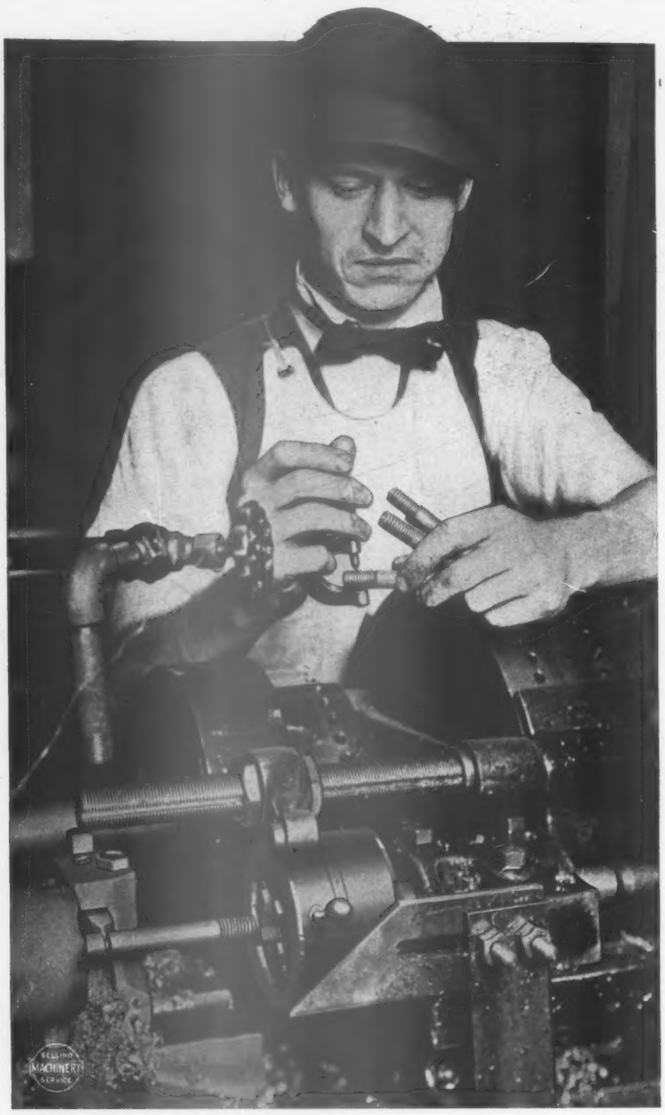
EQUIPMENT B
For deep internal work. Extension arm has 10-inch reach. 10,000 R.P.M. Arm interchangeable with internal spindle on Equipment A.



EQUIPMENT C
For button dies. Will grind 20 an hour. Interchangeable with A and B.

DUMORE HIGH SPEED GRINDERS

THE GEOMETRIC TOOL COMPANY
NEW HAVEN . . . CONN.
CHICAGO STORE 627 WEST WASHINGTON BLVD.



Do You Thread Tubing to Close Limits?

It was the Boehm Die Head that cleared trouble off the tracks for the Gemmer Co., Detroit. One of their threading jobs is cutting a particularly accurate thread on steel tubing for steering columns. The steel is hard—sufficiently hard to prove a tool's ability to cope successfully with any job that might offer; the thread is 7/8" diameter, 1/2" long, 20 pitch. With a Boehm Die Head the operator turns out 500 columns in 9 hours—accurate, clean cut threads easily and economically produced. The Gemmer foreman says this is far ahead of results secured with any die head previously tried, and that all concerned are entirely satisfied. The "Boehm" is the only die head which carries a universal taper attachment cam adjustable for any taper or length of thread. Other important features—let us tell you about them.

No More Trouble When You Use the BOEHM Die Head

RICKERT-SHAFER COMPANY

612 West 12th Street — NEW YORK OFFICE 50 CHURCH ST. — ERIE, PA., U. S. A.

MODERN
Self-Opening Die Heads

That Die Will Cut Those Threads

The determining factor of clean, sharp thread cutting in this shop is "Modern Self-Opening Die Heads." Talk thread cutting to any of the machine operators and they will boost "Modern"—the die head that is adapted to so many kinds of work.

You can't mistake a Modern Die Head. They stand out in fineness of workmanship, in quality of production, in quantity of work handled, and in length of service.

May we send you interesting data on correct thread cutting?

Modern Tool Company, Erie, Pa.

Main Office and Works, 200 State St., Erie, Penn.

DISTRICT OFFICES:

2 Rector St., New York City
32 North Clinton St., Chicago, Ill.
1223 Dime Bank Bldg., Detroit, Mich.
2 Greenwood Office Exchange, Cincinnati, Ohio

Isn't This a Beauty?

More Shells!
The Message from France
THE CLEVELAND TWIST DRILL CO.
The 1919 Calendar of The CLEVELAND TWIST DRILL COMPA
CLEVELAND, O.

A Vivid Patriotic Poster in Six Colors Sent free on request

The "MaxiTap"

(Patented)

The Extremely Sharp Hook

with which the lands of the "Maxi" Staybolt Tap are formed adds immeasurably to the long life and easy cutting properties, which are characteristic of this remarkable tool.

The "MaxiTap" will outlast two or three of the ordinary staybolt taps.

Make us prove it.

Greenfield Tap and Die Corporation

Greenfield, Massachusetts

New York, 28 Warren St. Chicago, 13 So. Clinton St.

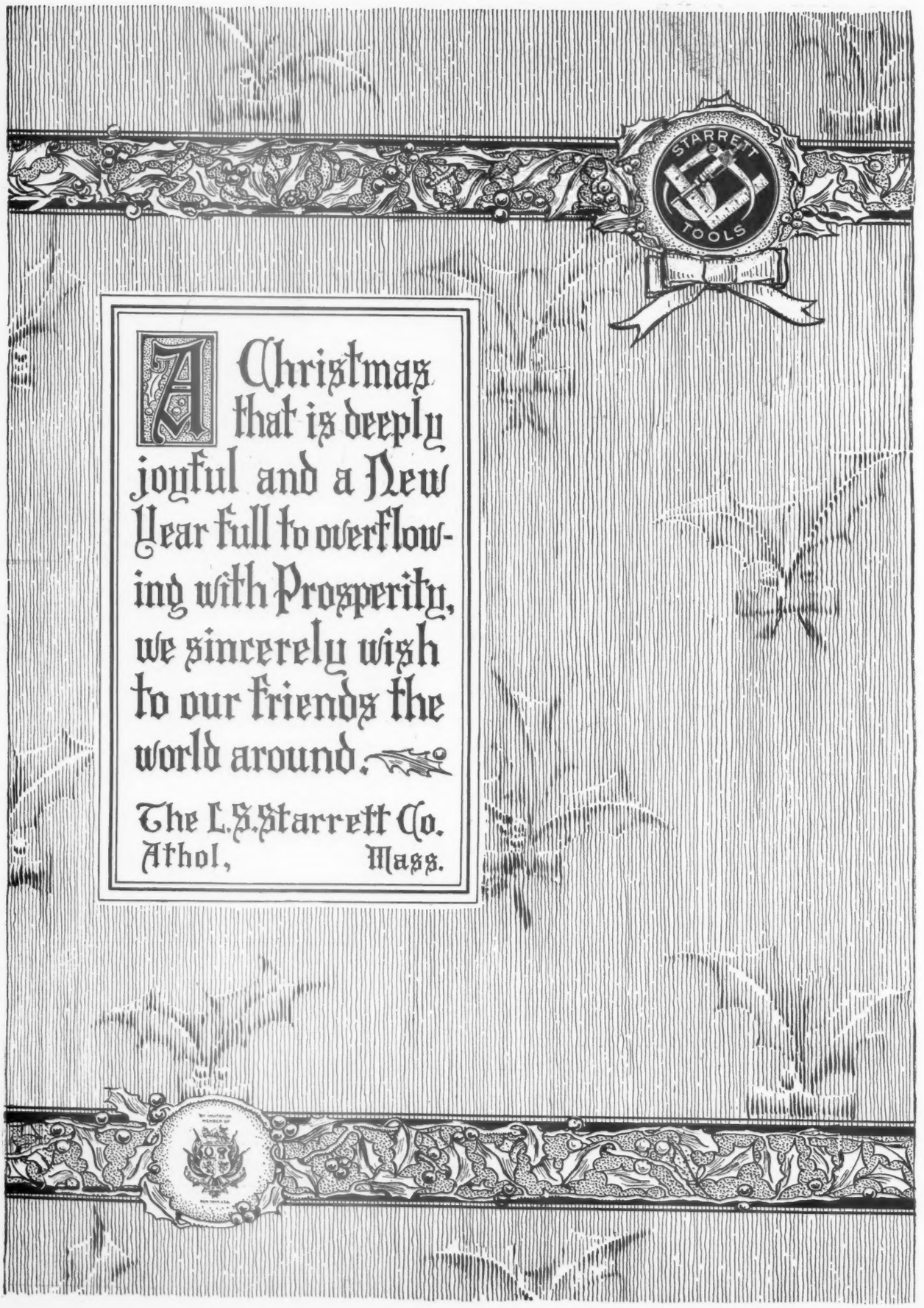
Detroit Office, 74 Congress St. W.

Canadian Plant, Wells Brothers Company of Canada, Ltd., Galt, Ontario

89

GTD

89


STARRETT
TOOLS
A Christmas that is deeply joyful and a New Year full to overflowing with Prosperity, we sincerely wish to our friends the world around.
The L.S.Starrett Co.
Athol, Mass.

Brubaker

THE TAP THAT "TAPS"

—More Holes
—Lasts Longer
—Cuts Sharp Threads
—Ultimately Cheaper

Brubaker quality is not a matter of chance—it is a scientific certainty, every time.

Special machinery insures accurate pitch and careful and correct relief. Improved methods of heat treating mean uniform and serviceable temper. Then there is the material itself. Brubaker taps are made of special material, selected for its ability to meet the most exacting requirements.

Speed and often extremely hard boiler plate is the class of work that "Brubaker Taps" are built for.

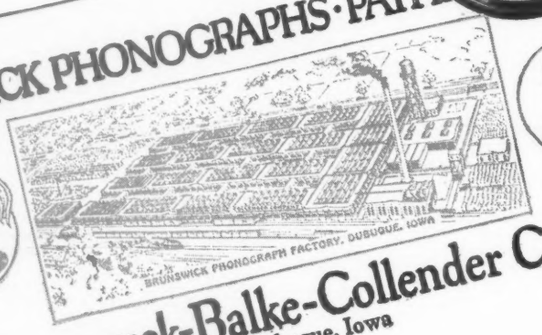
If you are not already using "Brubaker" taps, place a trial order. Brubaker performance will convince you of Brubaker economy.

W. L. Brubaker & Bros.

50 Church St., New York, N.Y.

STOCO
SAFETY GOGGLE
EYE SAVER

BRUNSWICK PHONOGRAPHS · PATH



The Brunswick-Balke-Collender Company
Dubuque, Iowa
May 15, 1918

Standard Optical Co.
Geneva, New York

Gentlemen;

We have used your Stoco Safety Goggles about one week only, but are very thankful that we have put the same in use, for the wearing of these goggles to-day, no doubt saved a man's eye sight. The mechanic in question was grinding on an Emery Cup Wheel when the same broke, one piece striking directly on the rim, which holds the lense in place. We feel sure if it had not been for these goggles this man would have been totally blind to-day for his other eye was put out some time ago. We wish that you would kindly put a new lense in the goggle which we are sending to you to-day. We are sending an order through our Chicago office for more goggles.

Yours very truly,

THE BRUNSWICK-BALKE-COLLENDER CO.
J. B. Grant

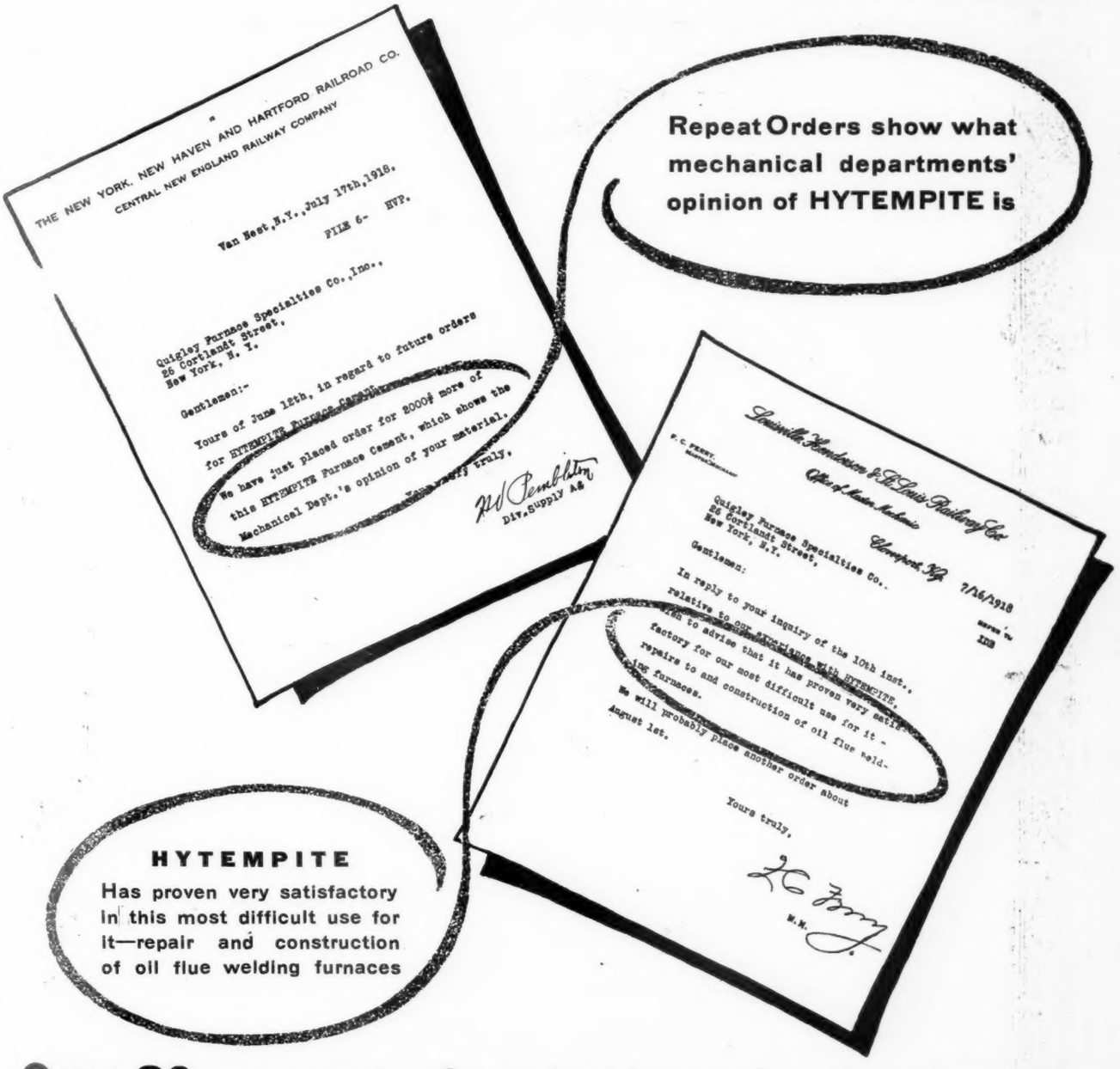
JBG/HT

STANDARD OPTICAL COMPANY
GENEVA, NEW YORK

What Railroads Think OF HYTEMPITE

(Reg. U. S. Pat. Office)

HIGH TEMPERATURE FIRE BRICK CEMENT


THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD CO.
CENTRAL NEW ENGLAND RAILWAY COMPANY
Van Nest, N.Y., July 17th, 1918.
FILE 6- HTP.
Quigley Furnace Specialties Co., Inc.,
26 Cortlandt Street,
New York, N. Y.
Gentlemen:-
Yours of June 11th, in regard to future orders
for HYTEMPITE Furnace Cement,
We have just placed order for 2000# more of
this HYTEMPITE Furnace Cement, which shows the
Mechanical Dept.'s opinion of your material.
Yours very truly,
Div. Supply Agt.
Louisville, Henderson & St. Louis Railway Co.
Office of Master Mechanic
Owensboro, Ky. 7/16/1918
Quigley Furnace Specialties Co.,
26 Cortlandt Street,
New York, N.Y.
Gentlemen:
In reply to your inquiry of the 10th inst.,
relative to our experience with HYTEMPITE,
wish to advise that it has proven very satis-
factory for our most difficult use for it -
repairs to and construction of oil flue weld-
ing furnaces.
We will probably place another order about
August 1st.
Yours truly,
M.M.

Repeat Orders show what mechanical departments' opinion of HYTEMPITE is

HYTEMPITE
Has proven very satisfactory in this most difficult use for it—repair and construction of oil flue welding furnaces

Over 80 per cent. of our business is repeat orders

QUIGLEY FURNACE SPECIALTIES CO., Inc.,

26 Cortlandt Street
New York

IMMEDIATE DELIVERY FROM STOCK AT

Baltimore
Birmingham
Chicago
Cincinnati
Cleveland
Detroit
Denver
El Paso
Los Angeles
Marshalltown (Iowa)
New York
Niagara Falls
Oakland
Portland (Ore.)
St. Louis
Scranton
Salt Lake City
Seattle
Montreal
Toronto
Vancouver
Winnipeg
Tokio, Japan

TOOL STEELS

Blue Chip

High Speed

and other

FIRTH-STERLING TOOL STEELS

THE knowledge, experience and skill of SHEFFIELD combined with the best PITTSBURGH practice have made these steels the standards of QUALITY and UNIFORMITY wherever Tools are used

FIRTH-STERLING
STEEL COMPANY

McKeesport, Pa.

NEW YORK BOSTON PHILADELPHIA
CLEVELAND PITTSBURGH
CHICAGO

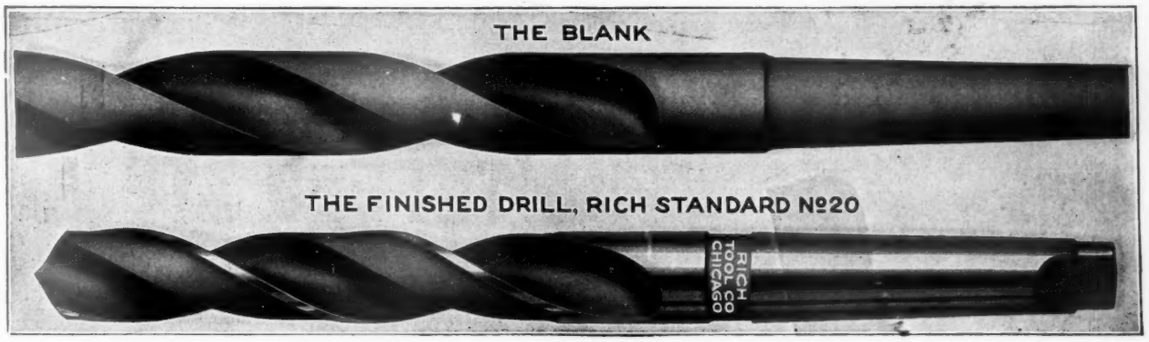
Series No. 1

Read This Series—You May Obtain An Idea Worth While—One You Can Use With Profit.

We Cannot Tell You All About Rich Tools In One Issue —Hence This Series.

PARTS of Locomotives, Automobiles, Aeroplanes, Guns, Machines, etc., subject to maximum stresses or shocks are first forged WHY? Because forging increases their physical properties—rearranges the structure to withstand stresses in any desired direction, and gives each portion the required amount of working.

At the proper temperature the flutes of RICH TOOLS are first forged and twisted, thereby arranging the structure to withstand the torsional stresses to the greatest degree. The result is a blank thoroughly uniform in every part and of superior physical properties to the bar from which it was made.



Not Welded, Brazed or Built Up—Made in One Piece

of the most suitable and best High Speed Steel of the proper composition—every operation and process is conducted with care and judgment.

It is unnecessary to tell you that this drill will produce maximum service—it is built for it.

Straight Shank No. 21, Long Set, Groove Shank No. 24,

Jobbers' Length No. 23, Short Set, Groove Shank, Short Length, Nos. 24-B and 24-C.

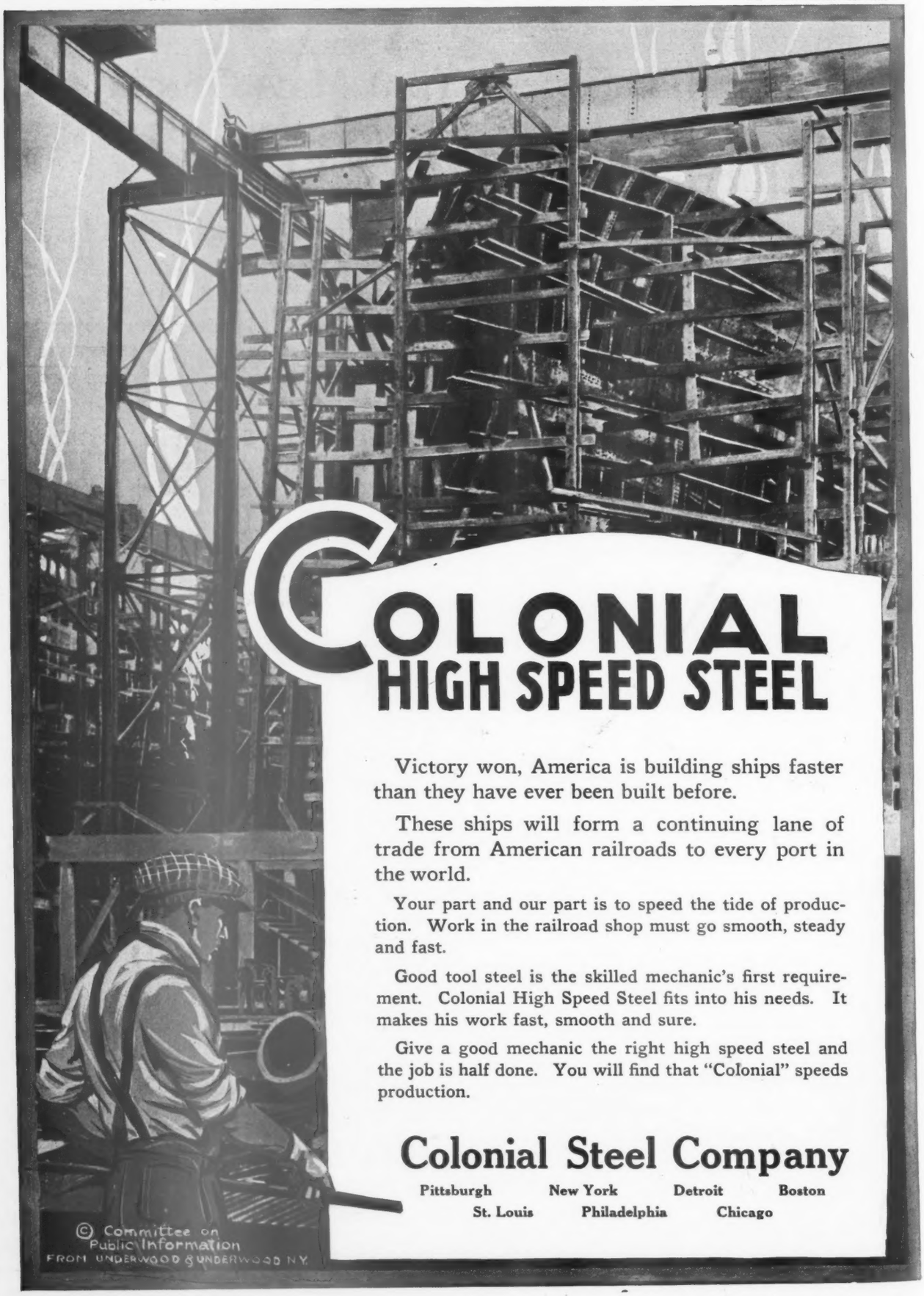
We also manufacture High Speed Bridge Reamers, Countersinks, Track and Bonding Bits—Rivet Sets, etc.

RICH TOOL COMPANY

MAIN OFFICE AND FACTORY

Railway Exchange——CHICAGO

Branches—Montreal, New Orleans, Philadelphia, Milwaukee, Portland, Kansas City, Seattle, San Francisco, Detroit,



COLONIAL HIGH SPEED STEEL

Victory won, America is building ships faster than they have ever been built before.

These ships will form a continuing lane of trade from American railroads to every port in the world.

Your part and our part is to speed the tide of production. Work in the railroad shop must go smooth, steady and fast.

Good tool steel is the skilled mechanic's first requirement. Colonial High Speed Steel fits into his needs. It makes his work fast, smooth and sure.

Give a good mechanic the right high speed steel and the job is half done. You will find that "Colonial" speeds production.

Colonial Steel Company

Pittsburgh New York Detroit Boston
St. Louis Philadelphia Chicago

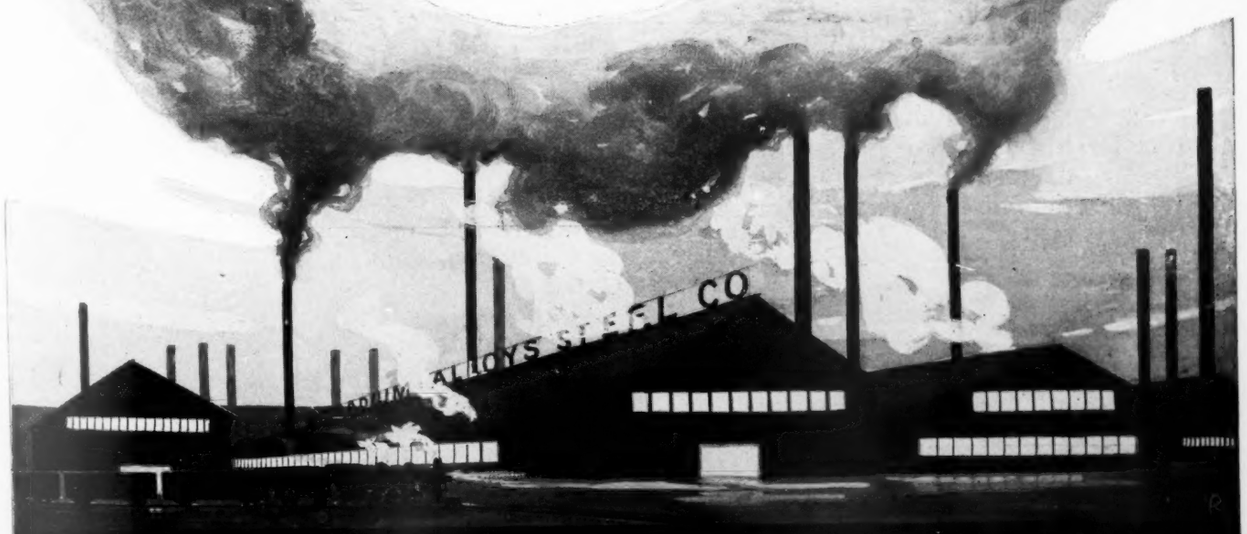
Has it ever occurred to you that the first cost of the very best High Speed Steel is infinitesimal compared with the value of the finished tool in constant daily service.

"Red Cut Superior"

The Nationally Known—First Quality

HIGH SPEED STEEL

THE BEST FOR ALL MACHINE WORK



VANADIUM-ALLOYS STEEL COMPANY

General Sales Offices: Pittsburgh, Pa. Works at Latrobe, Pa

"They have made good here"

I've got these Type T Reliance Motors on the hardest jobs in the plant. They have been tried out on pumps, blowers, machine tools and our special machines doing extra heavy work. They have stood up to the job in every case—our records show that.

In comparison with other motors I have found these to have more and better material in the vital parts. Shafts are big, bearings are big, end brackets are heavy, commutators are extra good. I have never had to rewind one because of defective or insufficient insulation. There's no skimping anywhere.

Bulletin 2014 tells just how Type T motors are made.

Reliance Electric & Engineering Co.
1084 Ivanhoe Road, Cleveland, O.

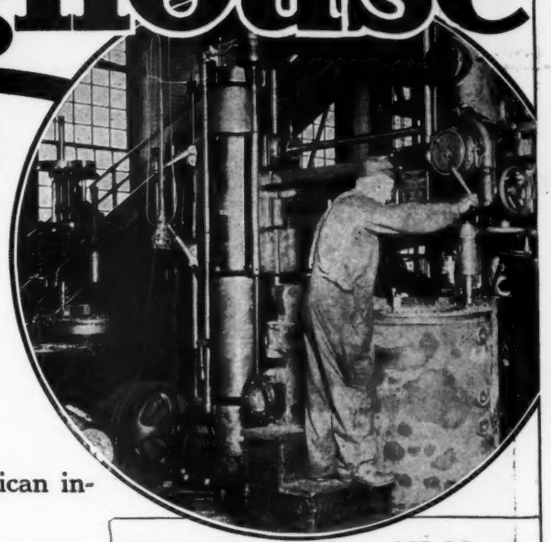
Branches: New York Philadelphia Pittsburgh Chicago

Type T Heavy Duty
RELIANCE MOTORS
Direct Current

Westinghouse

Machine Tool Motors and Control—

—Time Saving
—Labor Saving
—Fuel Saving



Westinghouse Type SK. Motor with control, driving Cincinnati Bickford radial drill in a Railroad Car Shop.

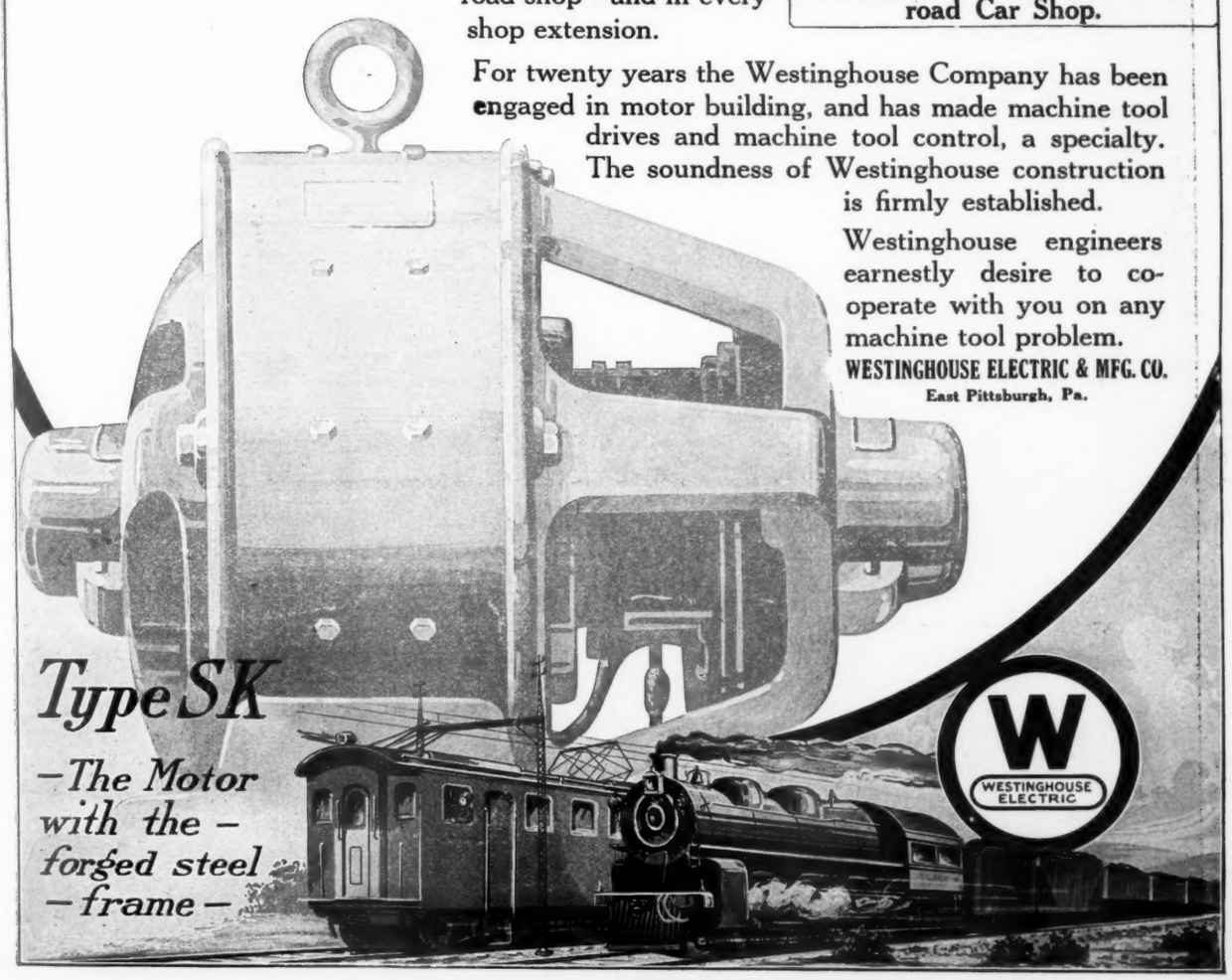
Electric drive forms a vital part of every American industry.

This time-saving, labor-saving, fuel-saving drive is installed on practically every machine that goes in the railroad shop—and in every shop extension.

For twenty years the Westinghouse Company has been engaged in motor building, and has made machine tool drives and machine tool control, a specialty. The soundness of Westinghouse construction is firmly established.

Westinghouse engineers earnestly desire to cooperate with you on any machine tool problem.

WESTINGHOUSE ELECTRIC & MFG. CO.
East Pittsburgh, Pa.



Type SK
—The Motor with the— forged steel —frame—

W
WESTINGHOUSE ELECTRIC

LINCOLN ARC WELDER

Big Four Saves 68 Hours

"How long will it take?" That's the first question these days when a repair job comes in.

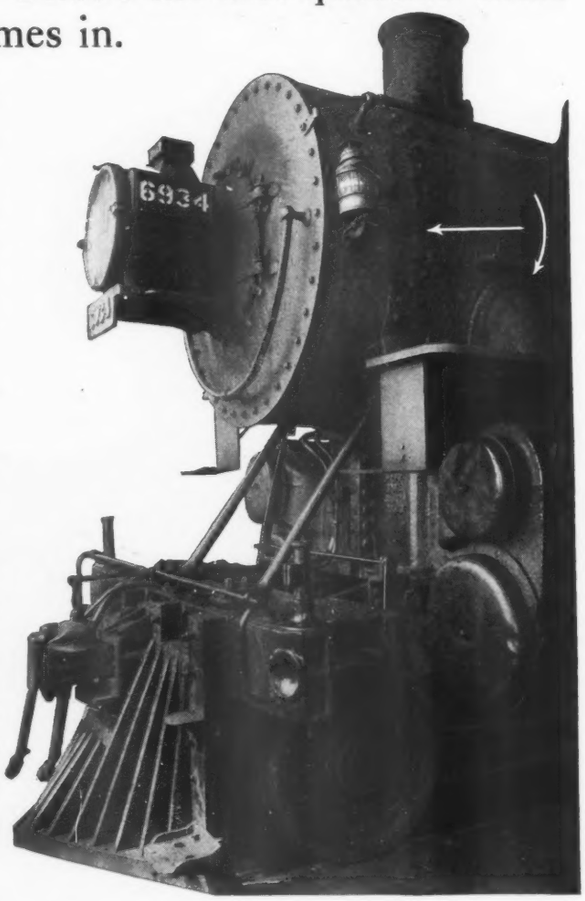
In some engine houses it would have been a three days' job to repair the steam pipe casing and smoke box of this engine. The rivets would have been cut out, the corroded plates removed, and the boilermaker's gang would have had to mark out, bend, drill and fit new plates.

But the Big Four R. R. doesn't do things that way.

With a Lincoln Arc Welder one man made a perfect repair of the leaks—welded them up solidly with a continuous seam of new steel. *Four hours later that locomotive was tested and ready for the road.*

There is hardly a repair in your shop from broken engine frames and leaky flue tubes down to a broken bell lever that could not be done better, quicker and more economically with a Lincoln Arc Welder than without one.

Why not write for Bulletin 104-G—you'll be interested.



Locomotive in the Big Four Shops at Linndale, O. Leakage in this locomotive has been repaired by welding around the steam chest pipe and in the smoke box so that the locomotive is practically as good as new.

This Lincoln Motor operated under water over **3 years** without damage.

The Lincoln Electric Co., Cleveland, Ohio

New York City	Chicago	Philadelphia	Charlotte, N. C.
Buffalo	Detroit	Pittsburgh	Boston
Syracuse	Columbus	Minneapolis	Toronto, Canada

Agencies in other principal cities

Where ARMCO IRON WELDING RODS are given a critical test

This picture shows how the K-G Welding Co. of New York utilizes ARMCO IRON filler rods in welding outlet tubes onto dished heads. After completion, the welds are subjected to 600 pounds hydrostatic pressure for half an hour and under this test the welds must be free from leakage.

We are advised by the K-G Co., who are making 10,000 of these heads, that ARMCO IRON is doing its work in a very satisfactory manner.

ARMCO IRON filler rods are the logical choice for oxy-acetylene or electric welding for many reasons. The uniform purity and metal structure assure a smooth even flow and thorough strength uniformity of the properly executed weld. This strength can be made consistent with any requirements by judicious thickness and location of the deposited metal.

Remember too that by making *a single composition* in *two tempers* to do well what has heretofore required a choice of one from many grades, ARMCO IRON welding rods effect big economies in the amount of stock that must be carried by a welding shop, and greatly simplify the whole scheme of welding.

Carried in stock by conveniently located representatives in all large industrial centers.

PAGE STEEL & WIRE CO.

Established 1883 as Page Woven Wire Fence Co.

Makers of "Copperweld" Copper Clad Steel Wire; ARMCO IRON Welding Rods and Electrical Wire; Wire Mill Products, Plain and Galvanized; Wire of Special Analysis; Wire Fencing for all Purposes; Factory Gates; Ornamental Iron Fence; Machine Guards; Tool and Stockroom Partitions; Architectural Iron.

Plants: Monessen, Pa., and Adrian, Mich.

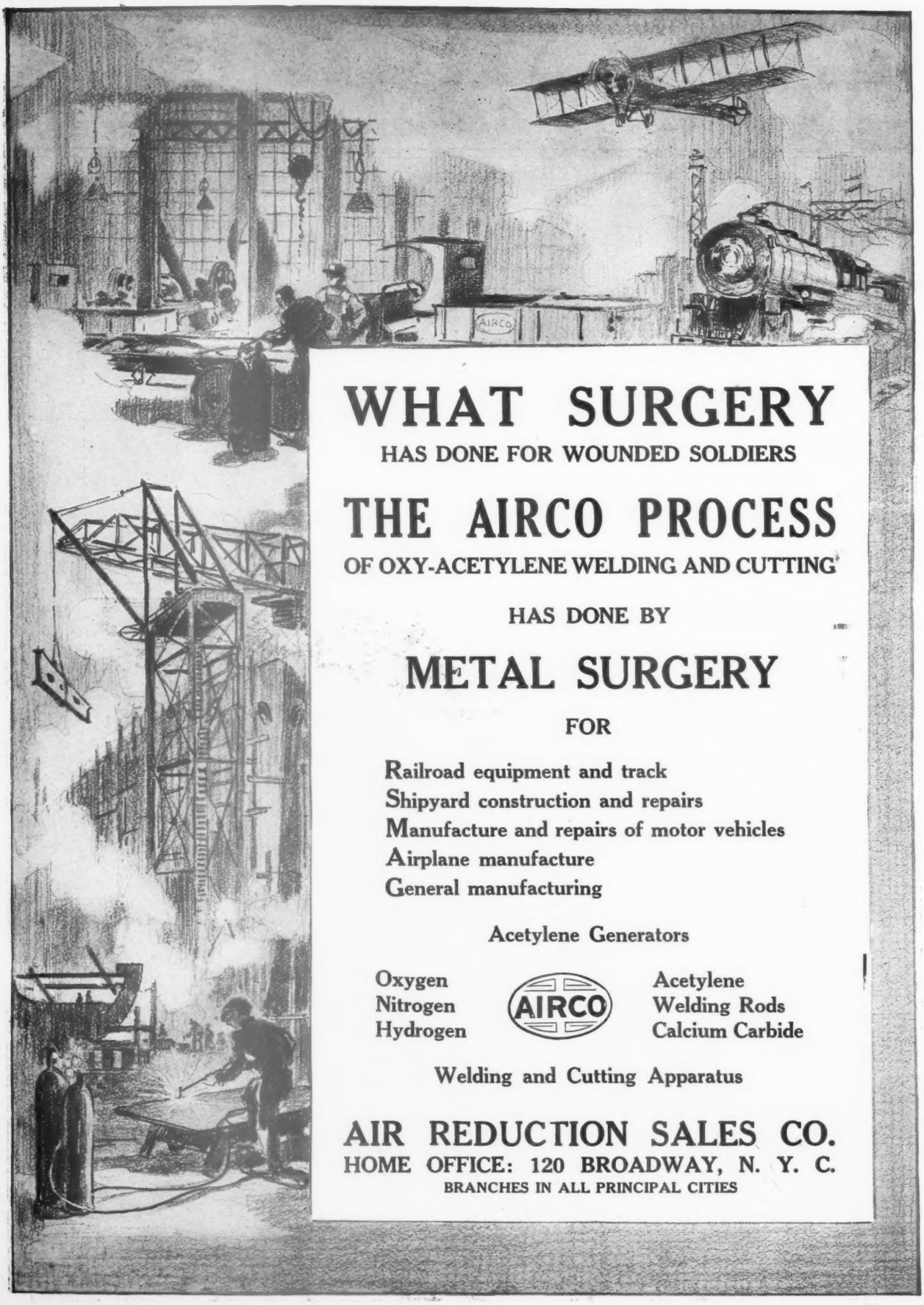
Sales Offices: 30 Church Street, New York

Western Representatives: Steel Sales Corporation, Chicago

29

AMERICAN ARMCO INGOT IRON

The trade mark ARMCO carries the assurance that iron bearing that mark is manufactured by the American Rolling Mill Company with the skill, intelligence and fidelity associated with its products, and hence can be depended upon to possess in the highest degree the merit claimed for it.



WHAT SURGERY

HAS DONE FOR WOUNDED SOLDIERS

THE AIRCO PROCESS

OF OXY-ACETYLENE WELDING AND CUTTING

HAS DONE BY

METAL SURGERY

FOR

Railroad equipment and track
Shipyard construction and repairs
Manufacture and repairs of motor vehicles
Airplane manufacture
General manufacturing

Acetylene Generators

Oxygen
Nitrogen
Hydrogen

AIRCO

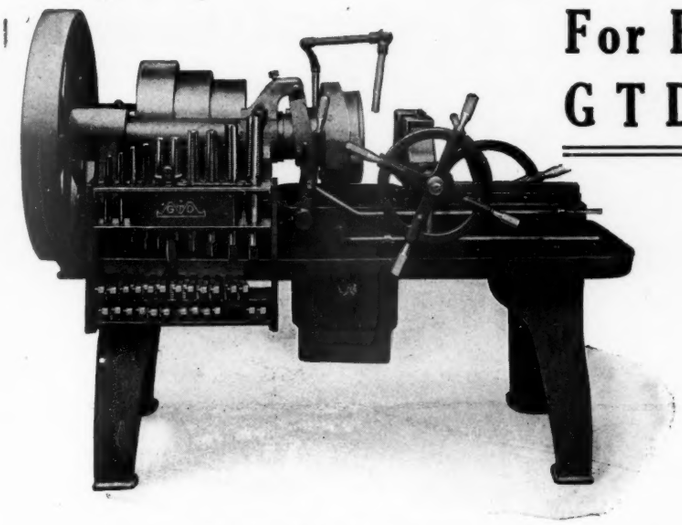
Acetylene
Welding Rods
Calcium Carbide

Welding and Cutting Apparatus

AIR REDUCTION SALES CO.

HOME OFFICE: 120 BROADWAY, N. Y. C.

BRANCHES IN ALL PRINCIPAL CITIES



For Bolts, Nuts and Pipe
G T D Threading Machine

An accurate, easy-to-operate, ruggedly built threading machine—capable of giving continued satisfaction through years of hard work.

Always ready—sizes easily changed. Nothing to get out of order.

Capacity to 2″ diameter.

Die opens automatically when desired length of thread has been cut.

Investigate!

Send for No. 39 Machine Tool Catalog

Machine Tool Division

Greenfield Tap and Die Corporation

Greenfield, Massachusetts

GTD

NUMBER FOUR

WILLIAM JAMES MAYO was born in the village of Rochester, Minnesota, in the year 1861; and four years later, his brother, Charles Horace Mayo, was born in the same place. These men are Surgeons, known all over the world—and people from all parts of the universe, rich and poor alike, have made a beaten path to the homes of these distinguished men—on the far plains of western Minnesota.

In 1915 these two brothers donated $1,500,000 to establish the Mayo Foundation for Medical Research—at Rochester, Minnesota. They have had highest degrees conferred upon them by foremost medical colleges and universities. Their success in saving human life stands out as one of the noblest and most heroic achievements ever recorded.

Their success is the result of

CONCENTRATION

As the Mayo Brothers have concentrated on *their* profession, so we "Victor" folk here in Springfield have concentrated on the manufacture and perfection of Victor Hack Saw Blades, to the exclusion of everything else.

As a result of concentrating on the perfection of this one tool, we have discovered many ways for improvement—and have created new processes.

Today the man who uses a Victor Hack Saw Blade, may safely expect from it a higher degree of satisfaction and a larger measure of service than he is likely to get from any other blade.

The Victor Hack Saw Blade is the outgrowth of years of experience, practical tests and much scientific research work.

Victor Blades increase the efficiency of the user and insure a definite saving in money

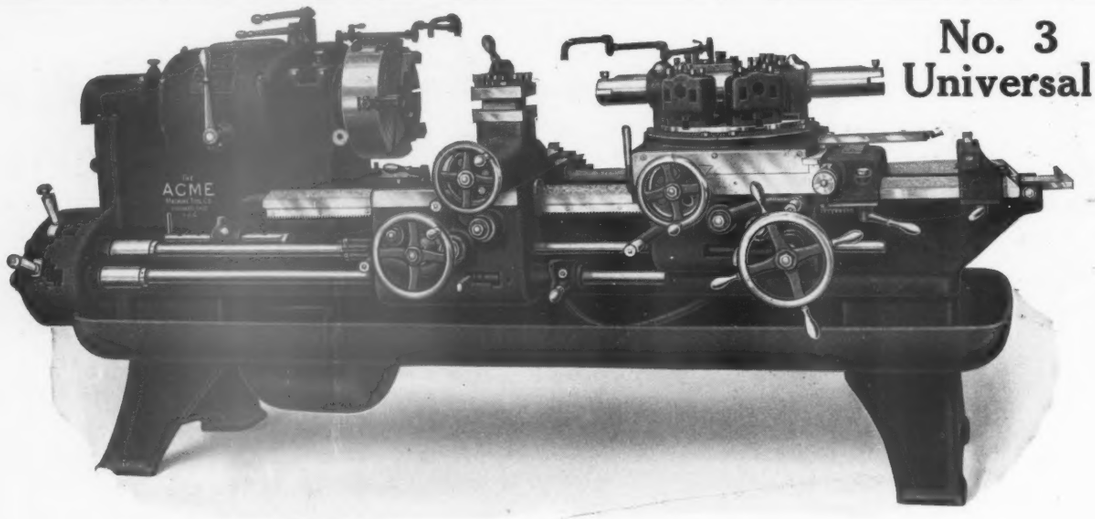
VICTOR SAW WORKS

(Formerly Massachusetts Saw Works)

SPRINGFIELD, MASS.

U. S. A.

VICTOR HACK SAWS



No. 3
Universal

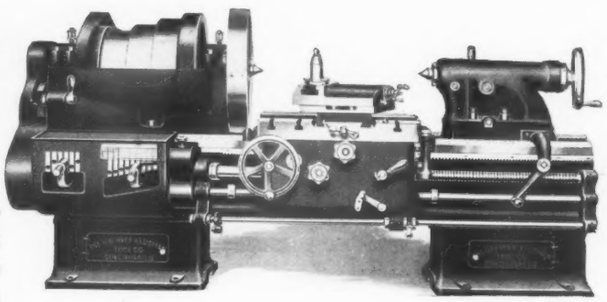
Cincinnati Acme Flat Turret Lathe

Cincinnati Acme Flat Turret Lathe is a general purpose machine. In railroad shops where maximum efficiency is demanded, only machines capable of a wide range of work are considered. The Cincinnati Acme Universal No. 3 meets the requirement. Bar work or Chucking work—Multiple or long run production—it makes no difference, all are handled with equal facility. ***Send for Catalog***

THE ACME MACHINE TOOL CO. **Cincinnati, Ohio**

Flat Turret Lathes—Screw Machines—Turret Lathes

Every Day Performance Makes Big Shop Schedules Possible



The problem of maintaining big shop schedules is often a troublesome one for the Machine Shop Foreman, a difficult one to solve. Frequently the jobs are of such a character that his machines may lack the stamina for the heavy cuts—the constant and sustained effort necessary to meet the demand.

G-K Lathes

The Greaves-Klusman Tool Co.
CINCINNATI, OHIO

are designed for heavy feeds—power and rigidity are distinctive features. Convenience in operation is essential where speed is required. G. K. Lathes are easy to operate—handy to control—every lever so conveniently placed that operator can maintain speed without undue effort. Our Booklet G. K. Betterments tells the story. A card will bring it to you.

60 Minutes from Floor to Floor

Few machines, if any, will exert a greater influence on increased shop production than a good boring mill.

The reverse is true of a poor one. Tire boring with an unreliable mill is usually a troublesome problem—an expensive one to solve. It means heavy outlay in overtime—with frequent delays due to break-downs, often halting the work indefinitely. Fortunate indeed is the shop with a

Cincinnati Heavy Duty Boring Mill

at its disposal. A Tire an hour from floor to floor is a typical Cincinnati performance for the boring operation. Speed and control—with a variety of feeds immediately available—are features. Independent feed mechanisms for each head is distinctive with the Cincinnati, and you can't break the gears by careless handling.

Strong and massive—with abundant power for constant and exacting effort, a Cincinnati in your shop will prove a revelation as a producer.

Let Us Describe These to You in Detail.

The Cincinnati Planer Company

CINCINNATI, OHIO

Where Your Scrap Pile Is an Asset

THOSE odds and ends of scrap high speed steel have a greater value than mere scrap. They are precious—they should never be sold as scrap.

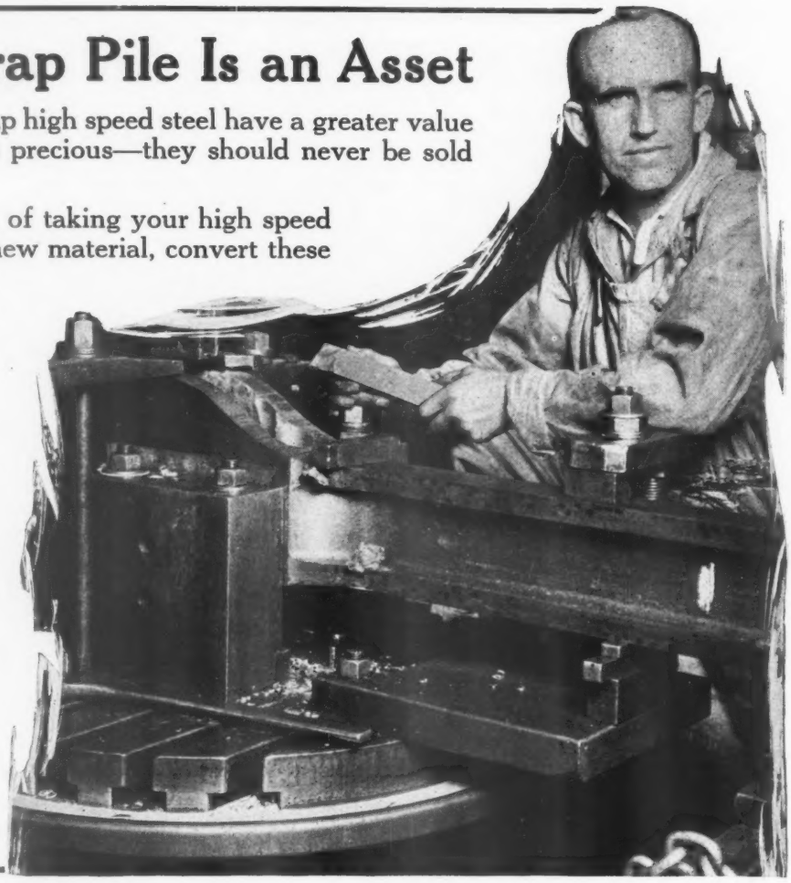
The Onondaga Process consists of taking your high speed remnants and, by additions of new material, convert these useless pieces into ingots which are in turn shaped into high speed steel bars.

HIGH OA SPEED

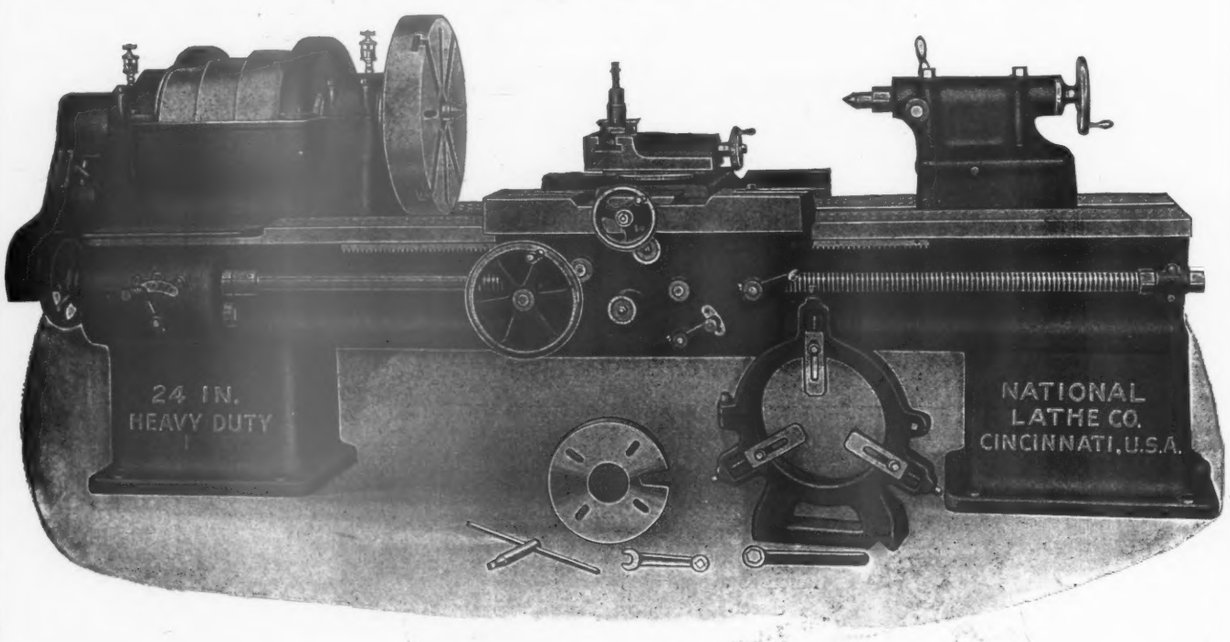
"That tool sure does remove the stock," said the operator of this machine. And it is a piece of Onondaga reclaimed high speed steel.

May we demonstrate the economy of this process? A trial is all we ask.

Onondaga Steel Company, Inc.
Syracuse, N. Y.

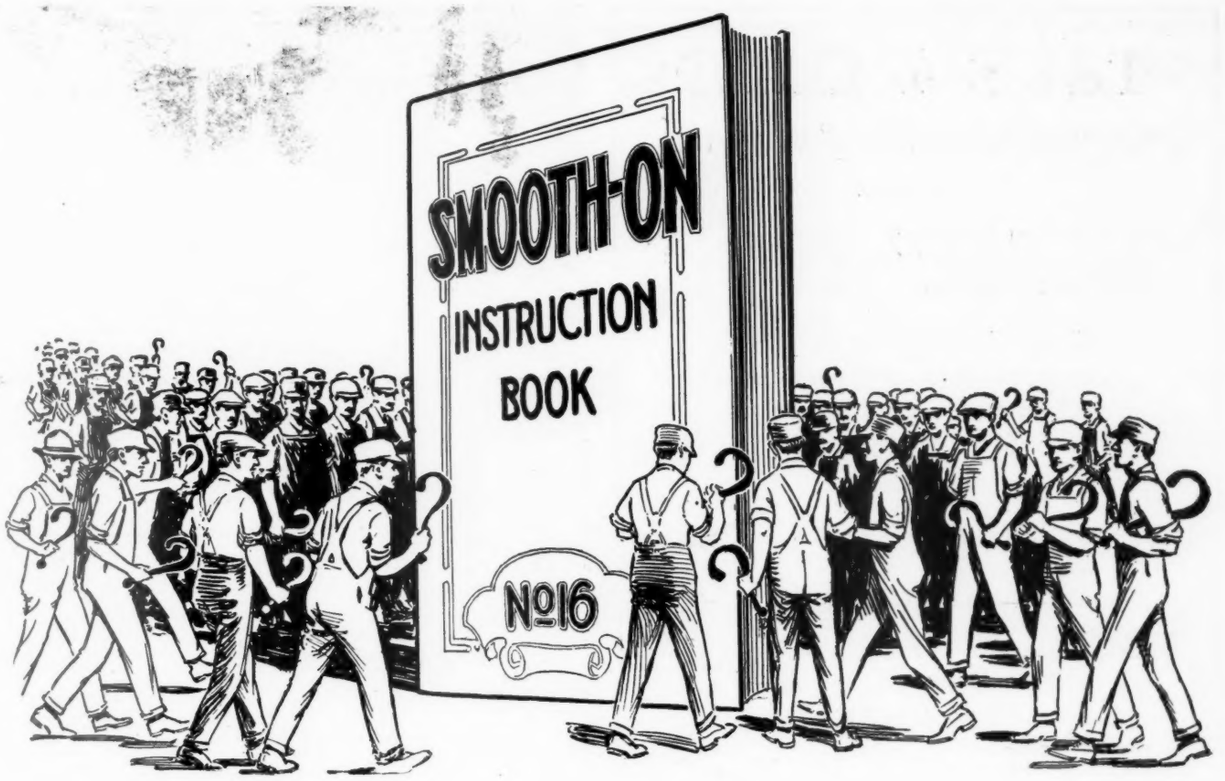


This Lathe will save money on Heavy Work



24" Heavy Duty Engine Lathe

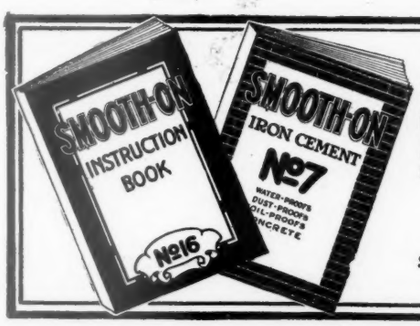
THE NATIONAL LATHE CO. **Cincinnati, O., U. S. A.**



Bring Your Questions to the Big Free SMOOTH-ON Book

No matter what kind of difficult repair you are called in to make around the plant, the chances are that some brother engineer has run into the same kind of thing and has described a good way to do the job in the SMOOTH-ON Instruction Book No. 16.

Here are 144 pages of just the information you are looking for, written by licensed engineers, well illustrated with photographs and drawings. And one of the best things about it is that it's *free*—just send your name and address and your copy will be sent you.



We have two valuable books for Free Distribution. Send Postal or use Coupon. Smooth-On Instruction Book No. 16 is just off the press with 144 pages of Power Plant data. Smooth-On Instruction Book No. 7 should be in the hands of every man with "dusting" and "damp-proofing" problems to solve.

SMOOTH-ON MFG. CO.
Established 1895
570-574 COMMUNIPAW AVENUE
JERSEY CITY, N. J., U. S. A.
Smooth-On Specialties Are Sold by Supply Houses.

Send the Coupon Today

Smooth-On Mfg. Co., Jersey City, N. J.

Gentlemen:

( ) Smooth-On Instruction Book No. 7.
( ) Smooth-On Instruction Book No. 16.

Name .....

Address .....

THE ROAD
proves the shop's work

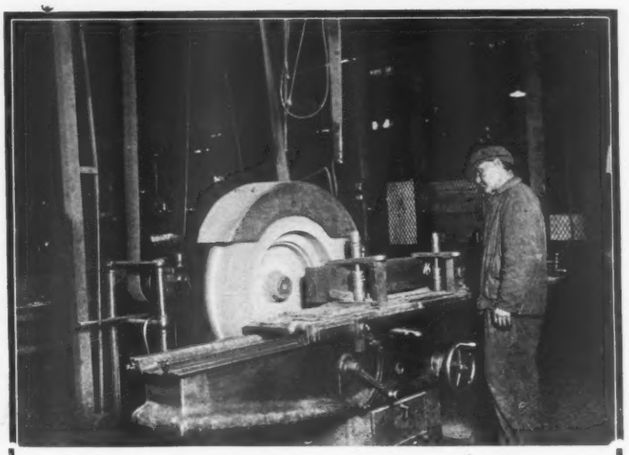
"MORSE" TOOLS

with their ability to turn out accurate work at high speed will help your jobs to pass the road test.

Drills, Reamers, Taps, Cutters

CATALOG ON REQUEST

Morse Twist Drill & Machine Co.
New Bedford Massachusetts



"DIAMOND" *Dependability*

The present crisis has developed many previously unthought of possibilities in Diamond grinders. Marked adaptability to a field of greater scope than was thought possible in pre-war days—especially in railroad work—has made the Diamond one of the most dependable tools in the shop.

Let us tell you what they can do

Diamond Machine Co.
Providence - - R. I.

Bardons & Oliver

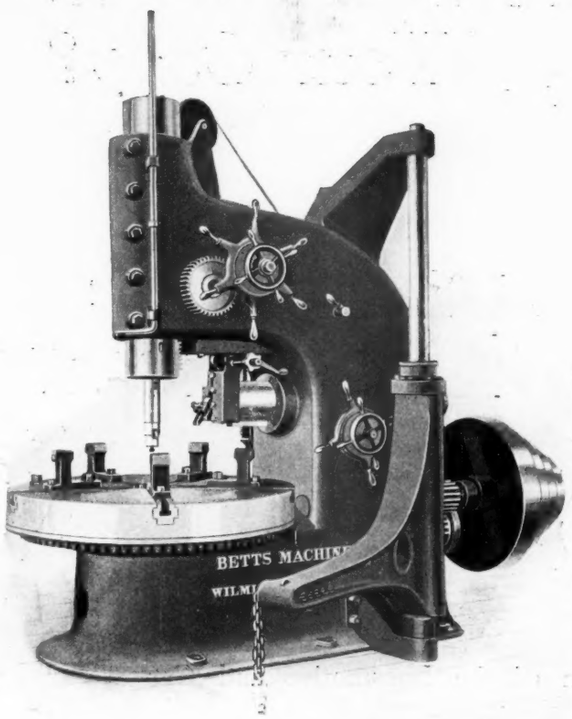
A direct connected, constant speed motor eliminates belts and countershafts, gives a free space overhead for crane travel and permits the locating of the machine anywhere in the shop.

This machine is speeding up the production of brass parts in most modernly equipped shops. Jobs that must be handled quickly and in a workmanlike manner—jobs where quality standards are exacting and shop costs are known to a fraction of a cent, the value of a B. & O. Direct Connected Fox Lathe is both popular with the workmen and shop officials.

For Speed on Short Runs

For bar stock jobs, we have many sizes of Turret Lathes to meet your Requirements. For brass work, investigate the B. & O. Fox Lathe.

BARDONS & OLIVER Cleveland, O.



Car Wheel Borers

A Heavy Duty Machine for Rapid Production

These machines hold the record in many prominent railroad and car shops.

Special machines for manufacturers of steel wheels are built to order.

Send for bulletins of our complete line of railroad tools.

Sherritt & Stoer Company, Inc.

Machine Tools—Railway and Machine Shop Equipment

Philadelphia, Pa.

Point of Contact

HAVE you ever tried to analyze your product as to its advertising possibilities? Have you ever gone deep down into its sales possibilities to find the "point of contact" between it and its possible buyers?

Often the "point of contact" is hard to find, for it is always the obvious that escapes us.

If a product or device makes for economy, savings, etc., obviously the point of contact is along these lines—but your message should be so placed before the maintenance of way man that your appeal comes within his experience.

Our copy-service department may be able to assist you in establishing the correct point of contact.

Call upon us to assist you whenever you feel that your copy-plan needs the viewpoint of the man outside

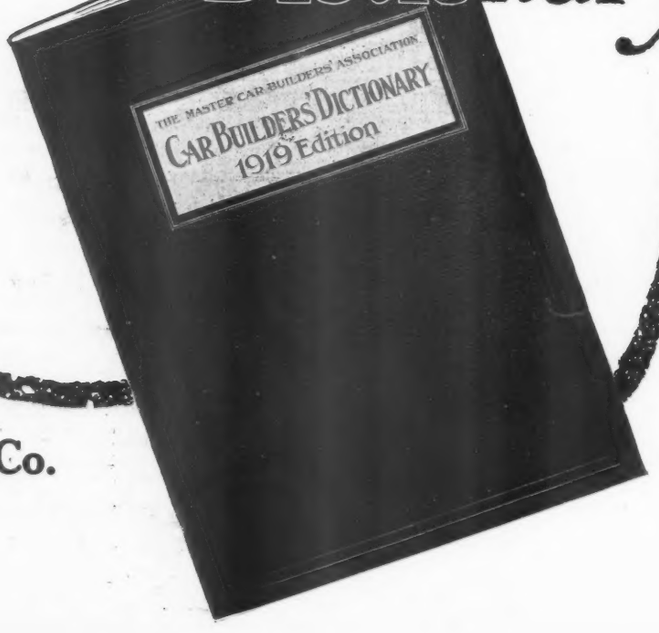
Railway Mechanical Engineer

Have You Ordered Your Copy?

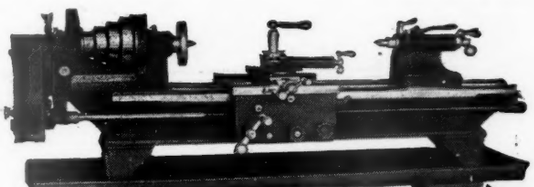
Locomotive Dictionary

THE 1919 edition of the Locomotive and Car Builders' Dictionaries will be off the presses early in January, 1919. Brought up to date, carefully supervised by the M. C. B. & M. M. Associations and greatly enlarged, these books will be a valuable working tool in the active library of railway officers, mechanical officials and their immediate assistants. Have you ordered your copy? Cloth binding $8.00. Full leather $10.00. Order today!

Car Builders' Dictionary



Simmons-Boardman Pub. Co.
Woolworth Building
New York, N. Y.



11-in. x 5-ft. Star Engine Lathe on oil pan

STAR LATHES

These Savings---

(1) Floor Space
(2) First Cost
(3) Power

These are the savings brought to customers who use Star Lathes with the idea of developing the scope of the "small lathe."

The secret of the Star Lathe—the factor that differentiates it, is the exceptional accuracy and rigidity.

Star Lathes are in every way built with the care given to heavier equipment of high accuracy. **Star Lathes are able to replace heavier, more expensive equipment,** and are constantly handling work that was thought to require such equipment.

This means the big savings noted.

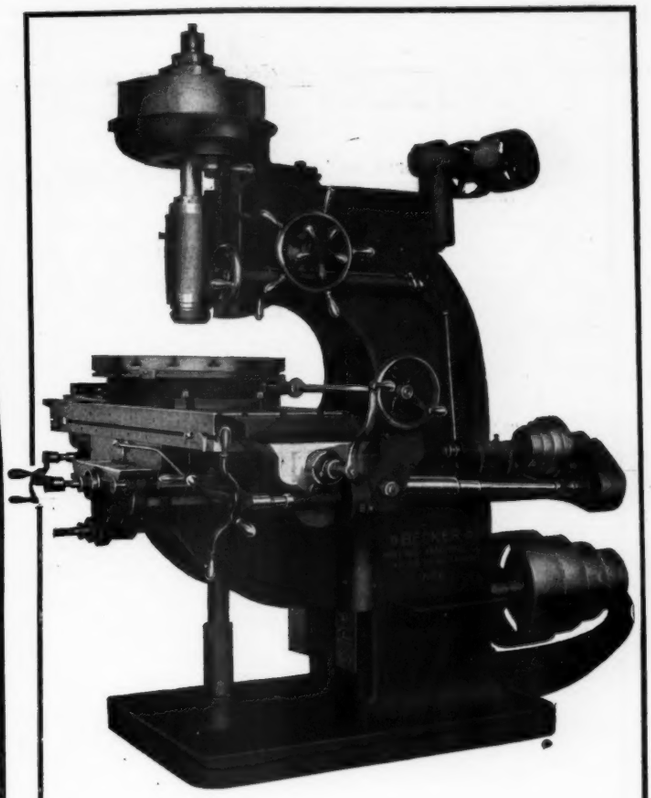
Furthermore, simplicity of operation makes the Star Lathe a keen factor towards getting more work through under difficult conditions.

Write for further facts. Ask for a copy of the Star Lathe Catalog.

The Seneca Falls Manufacturing Co., Inc.

385 Fall Street, Seneca Falls, N. Y.

9-in. x 4-ft. Star Engine Lathe



Becker Supremacy.

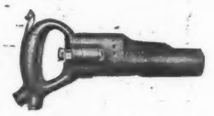
Wherever you find a Becker Miller —and you'll find them in the majority of well equipped railroad shops —you invariably find a producer— a busy and popular machine.

It may be doing any one of a score of jobs—now commonly done on a Becker — that formerly was regarded as impossible, or at least impracticable. It is, perhaps, due to this flexibility—this ability to handle quickly and well—so many jobs of wide scope and character—that has made Becker Supremacy an actuality—now known and recognized wherever used. Strength —power and durability, too, are features that have influenced the verdict—all combined in the Becker to a marked degree. A card will bring you the details. Mail it today.

Becker Milling Machine Co.
Hyde Park Mass.

No. 80 "Little David" Long Stroke Riveting Hammer with Inside Trigger

"Little David" Pneumatic Tools

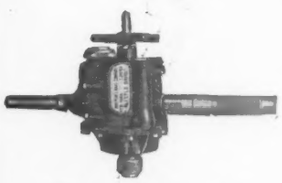


No. 3S "Little David" Chipping Hammer

If you will watch a "Little David" Tool at work, you will see that it is more speedy than others—enough so to justify its use on that ground alone.

But if you measure the air consumed, you will find a power saving per unit of work,—and continued service will show a marked decrease in the item of lost time due to breakage, and expense of spare parts.

Superior design and methods of construction make "Little Davids" the most economical air tools.



No. 2 "Little David" Non-Reversible Drill

No. 33SC "Little David" Reversible Drill

No. 7 "Little David" Grinder

No. 80 "Little David" Long Stroke Riveting Hammer

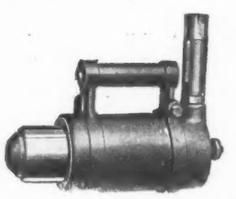
The "Little David" Catalog tells all about them. Ask for a copy.

No. 4 "Little David" Holder-on

INGERSOLL-RAND COMPANY

11 Broadway, NEW YORK — 165 Q. Victoria Street, LONDON

Offices the World Over



No. 1 "Little David" Jam Riveter

77-PT

USERS of Hartness Automatic Dies should, in ordering chasers, specify if they are wanted for cutting *short threads.*

In addition to the *lead controlling* chasers which we have made for so many years, we are now making a *short thread* type, especially for cutting threads shorter than the width of the chasers, where extreme accuracy of lead is secondary

Cutting Threads Without Taper

in importance to having the threads without the slight taper that is shown when the lead controlling type is used for short threads. We do not recommend the *short thread* type for threads longer than the width of the chasers, since they do not possess the lead controlling feature. The lead control belongs exclusively to our regular chasers and is not found in any other make.

JONES & LAMSON MACHINE CO.,

(Automatic Die Department)

General Office and Works - - SPRINGFIELD, VT., U. S. A.

Branch Offices: 109 Queen Victoria Street, London. 503 Market St., San Francisco.

Domestic Agents for Dies and Chasers:

Boyer-Campbell Co., Detroit.
Carey Mchy. & Supply Co., Baltimore.
E. L. Essley Mchy. Co., Chicago, Milwaukee and Moline.
E. A. Kinsey Co., Cincinnati and Indianapolis.
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Steel for Service

The engineers of this company have had a wide range of experience in connection with the wearing qualities of various grades of gears.

They, as well as you, have found that a very important feature of quantity production is the necessity of employing inspectors and skilled mechanics to examine all machinery and to keep it in repair as an insurance against delays in production.

Gears are an important link in the chain of production of any plant. If an individual gear fails, production on that machine is tied up until a new gear is secured and installed.

Many manufacturers use gears made from

Carnegie Rolled Gear Blanks

to cut down this heavy cost of inspection and to insure continuous maximum production. These gears are so strong and tough that they possess superior wearing qualities; they usually save the cost of three renewals, three new gears, three installations and three interruptions to production.

This company's engineers will be very pleased to confer with you on your gear problems. It may be that they will be able to offer some suggestions that will be of benefit to you.

Carnegie Steel Company

General Offices, Pittsburgh, Pa.

1065-A

Trade Mark Registered U.S. Patent Office

L-XX HIGH SPEED

AND OTHER

TOOL STEELS of QUALITY

Our special railway machine shop service department is at your command without obligation to you. It's a money saver.

ATLAS CRUCIBLE STEEL CO.

DUNKIRK, NEW YORK

Williams' Superior Drop-Forged Wrenches
For Every Purpose

FOR nearly half a century we have been designing and developing standard lines of drop-forged wrenches to meet all recognized trade needs.

We make and carry them, Little and Big, Straight and Bent, *Thin* and *Thick*, with openings from 3/16 to 7 5/8 inches:—

Something *Standard* for all requirements that can be standardized:—

Something that is *Superior* because our methods and processes from material buying on up to the completed tool enable us to embody in our wrenches the experience gained in quantity production of goods of the highest grade for many purposes.

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THE WRENCH PEOPLE
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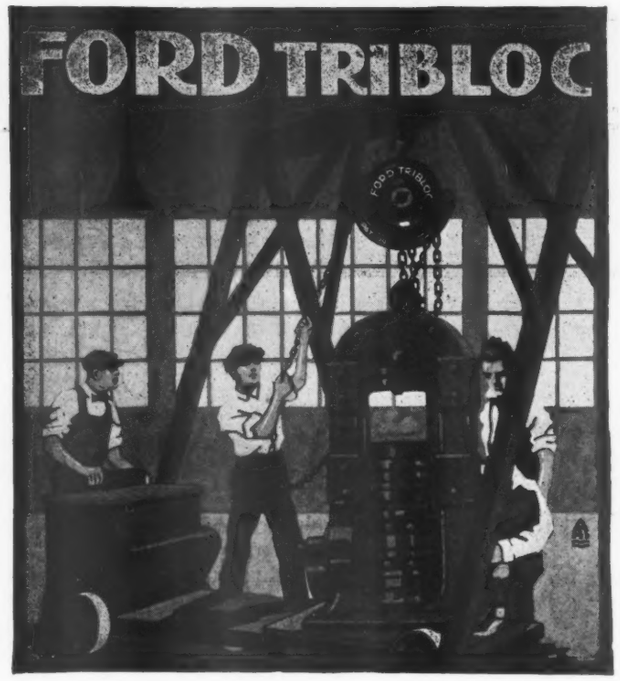

For Handling Heavy Machinery

A hand chain hoist is unapproached for handling heavy machinery or piling heavy stock in close quarters or short headroom. And there need be no hesitation in handling the heaviest parts if the hoist selected is a Ford Tribloc. For the Ford Tribloc will hoist or hold safely 3½ times its generously rated load as a result of steel working parts and its LOOP Hand Chain GUIDE that prevents damage to the block due to "Gagging."

Write for Catalog 3, giving the details of construction and our 5-year guarantee.

Ford Chain Block & Mfg. Co.
Second and Diamond Streets, Philadelphia, Pa.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
120 BROADWAY, NEW YORK, U.S.A.

2119-D

TRADE YALE MARK

Hoisting with

the YALE Spur-Geared Chain Block is SAFE, SPEEDY, SURE.

The peace of mind, speed and ease of operation and reliability—all naturally result when using YALE.

The most convincing argument is the Block itself.

'From-Hook-to-Hook-a-Line-of-Steel'

For Sale by Machinery Supply Houses
Send for Catalog

The Yale Spur-Geared Block

For factory locking equipment use a Yale Master - Key System. Write for particulars.

The Yale & Towne Mfg. Co.

9 East 40th Street New York

THE MARK OF SERVICE

This mark has a double meaning to wrench users. This mark represents a service that has stood the test for over 75 years—a service capable of standing 30% overload.

Coes wrenches are backed by years of experience. Coes wrenches are designed right—built right—inspected 16 times during its manufacture to make doubly certain of its construction.

If you are not now using "Coes" wrenches, just place a trial dozen in the hands of your workmen—the fellows who know from actual experience what is best for their needs—then base your opinion of wrench service on what these fellows say. We know the answer—it will be "Coes Wrench"

COES WRENCH COMPANY
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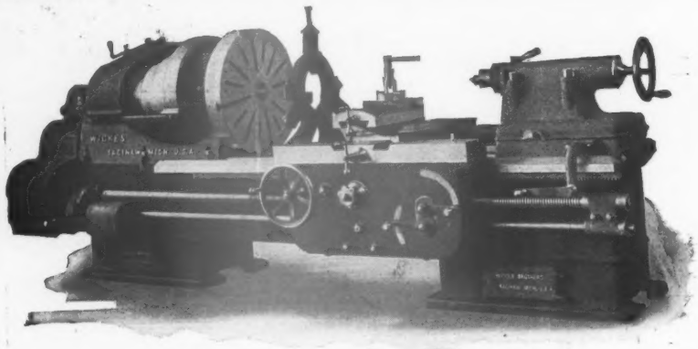

32" Wickes Heavy Duty Engine Lathe

WICKES

Heavy Duty Engine Lathe, Built any lengths, has 3 step cone, is double back geared and has double plate apron. Built belt or motor driven.

Let us tell you about this and also our 26" and 18" lathes.

Wickes Bros.
SAGINAW - MICH.

Rockford Horizontal Drilling, Boring and Tapping Machine

SEND FOR THE FACTS ON THIS MACHINE

This Rockford Horizontal Drilling, Boring and Tapping Machine, made in six combinations, is sufficiently accurate for the finest jig work. It has lateral and vertical head adjustment for surfaces 18" high by 36" wide. Drives high speed drills up to 3" diameter, and bores up to 8" in diameter. Extra heavy and durable construction. Weight distributed to offer full rigidity. Levers conveniently located. Send for further information today.

Rockford Drilling Machine Company
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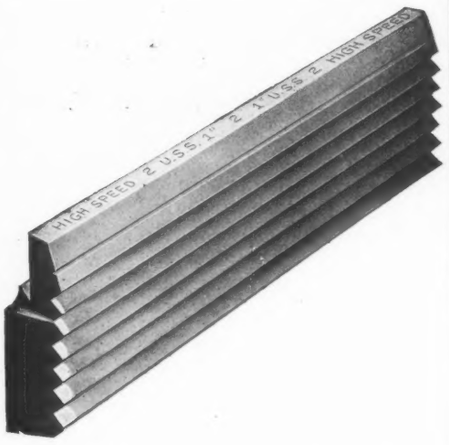
Also Mfrs. of Multiple and Single Spindle Upright Drills and Wet Tool Grinders

LANDIS DIE HEAD

Produces 30 ¼-Inch Bolts Per Minute



Threading 30-¼" Bolts per minute is the job of a Landis Die Head in a big plant. This production is not obtained spasmodically, but the head, day by day, has been maintaining this same steady pace.

The chasers used on this job have been ground but once in two weeks. Do you get the full meaning of this? The Landis chaser has at least three inches of available cutting material and only 1/32-inch is removed at each grinding. Consider then, the life of one set of chasers and the corresponding low cost of upkeep.

This same company have six heads in all installed and every one is producing results which have one meaning—the superiority of the Landis Die.

Do you obtain such results? Send us your specifications and let us prove to your satisfaction that the Landis Chaser will insure better threads, a higher production and an extremely low threading cost.

Catalogue No. 24 on request

Landis Machine Company
WAYNESBORO, PA.

ROOKSBY PORTABLE TOOLS

FOR RAILWAY REPAIR SHOPS

PORTABLE BORING BAR

Boring Bars for Reboring Locomotive Cylinders and Valve Chamber Bushings.

Crank Pin Machines for Truing Up Worn Crank Pins, New Design. Accurate work.

Portable Valve Seat Facing Machine.

"Safety First" Requirements Satisfied. Send for Illustrated Bulletin "L"

E. J. ROOKSBY & CO.

1070 Hamilton St. Philadelphia, Pa.

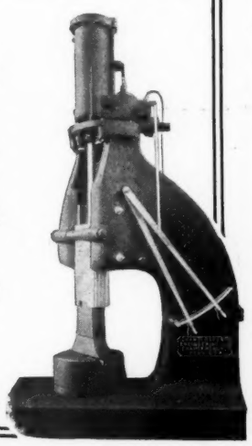
Meets Special War Time Conditions

Just as the war has created special conditions in locomotive work, the

CHAMBERSBURG SPECIAL SINGLE FRAME STEAM HAMMER

meets the demand for good work in quick time.

Chambersburg Forging Machinery has forged its reputation in the railway field on its Dependable, Economical and Serviceable qualities, all of which are represented in the 3,300 lbs. "Chambersburg Special" illustrated here.



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Conserve Time!

TIME is an all essential element. Napoleon was defeated because his expected reinforcements were behind **time**. Millions of dollars and thousands of lives are lost every year because men do not properly reckon with **time.**

At the present as never before in history, **time** must be conserved to the utmost degree. Every minute must yield its greatest possibilities.

BOWSER ESTABLISHED 1885

SYSTEMS

Fig. 109. Unit—a separate unit for each oil.

for the storing and handling of oil, conserve more than half the **time** expended by less efficient methods.

They also conserve:—

Labor	**Lives**
Capital	**Property**
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Machinery

Bowser Systems are leakproof, fireproof, lossproof, dirtproof, deterioration proof, evaporation proof, rapid, economical and efficient.

A System for every requirement. Write today.

S. F. BOWSER & COMPANY, Inc.

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Sales Offices in All Centers. Representatives Everywhere.

Jessop's Best Carbon Steel and "Ark" High Speed Steel

FOR DIES AND HIGH GRADE TOOLS

Always Uniform

Most Economical

Jessop's "Ark" High Speed Steel

Has Stood the test. Has many imitators but no equal

Manufactured in Sheffield, England

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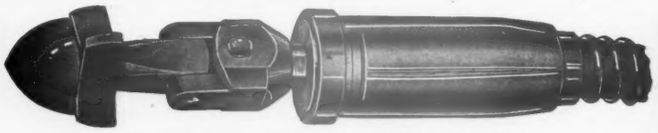
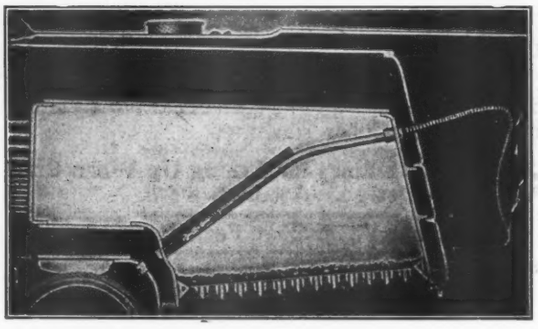
Boston Warehouse, 163 High Street St. Louis Warehouse, 714 No. 2nd Street *Warehouses throughout the U. S.*





Arch Tube Cleaning Made Easy

Cleaning arch tubes made easy and simple; that is the service performed by the

Roto Arch Tube Cleaner

Operated by a standard 9½ inch air pump

Notice its tapered form which permits it to pass easily around the bends of a 3" arch tube. With the Roto, arch tubes are cleaned much faster than by any other arch tube cleaner. Why? Send for Bulletin No. 44 and get the full answer.

THE ROTO COMPANY, Hartford, Conn.

WHITING-ADAMS BRUSHES

Disgusted with the Brush you are using?

Some brushes have no excuse for being on earth.

Have you one of this kind?

Try a WHITING-ADAMS BRUSH

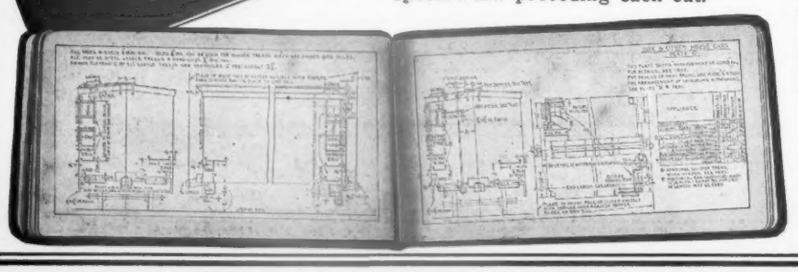
Do you know what WHITING-ADAMS means?

It means satisfaction in brushes, good work, long wear, best results. Send for Illustrated Literature.

JOHN L. WHITING - J. J. ADAMS CO., Boston, U. S. A.

Brush Manufacturers for Over One Hundred Years

Whiting-Adams Brushes Awarded Gold Medal and Official Blue Ribbon, the Highest Award at Panama-Pacific Exposition, 1915



CAN YOUR ROAD AFFORD TO BE WITHOUT **This Book**

Approved by the Master Car Builders Association—"United States Safety Appliances for All Classes of Cars and Locomotives"—includes all the latest amendments and conference rulings. Clear illustrations of all classes of cars and locomotives, showing the correct legal application of all safety appliances with the specific law preceding each cut.

This Book is needed by every repair foreman, car inspector and repairman on your road, every manufacturer of cars and locomotives, every man having to do with the checking up of or application of Correct Safety Appliances.

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Leather binding, $1.50.
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Speed up Your Boiler Work with

FAESSLER TOOLS

Answer the call for bigger production with Faessler Tools. They meet the present situation squarely. Not only do they reduce the number of men required for the work but they increase the productiveness of every man who uses them.

The Faessler Safety Sectional Expander leads our list of production boosters. Others including sectional and roller expanders, superheater flue expanders, beaders and flue cutters are specially designed for use on locomotive boiler work. They are used in the shops that are clipping down the time of locomotive boiler repairs below the best of pre-war days.

Let us send you our catalogue and show you how you can save time and do better work even though you are short of men.

"Faessler Tools are Faster Tools"

J. Faessler Mfg. Co.

MOBERLY, MO.
St. Louis—Railway Exchange Building

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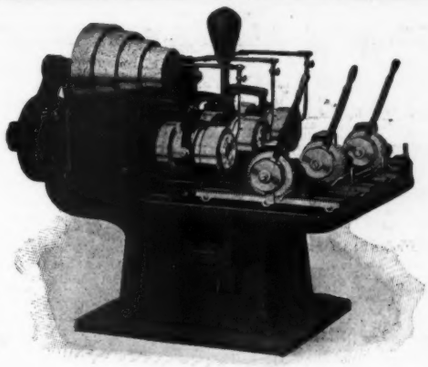


The National Bolt Cutter

saves you 30 to 50% in Die cost and machine upkeep.

In R. R. shops and Industrials results show that it costs less per bolt when threaded on the NATIONAL.

And users will tell you that the NATIONAL always cuts accurate thread. No tapering thread, no "oversize," no loose fits.

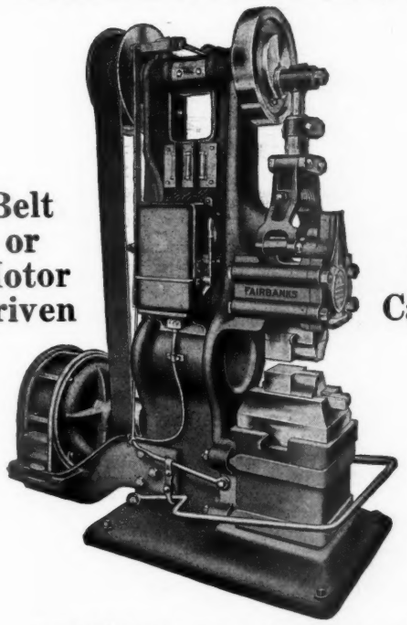
The NATIONAL gives you effective results with unskilled labor.

Built in ¾ to 6 Inch Sizes. Single, Double, Triple and Quadruple Spindle

The National Machinery Company
Tiffin, Ohio, U. S. A. 1

FAIRBANKS HAMMERS

Belt or Motor Driven



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UNITED HAMMER CO.

141 Milk Street **Boston, Mass.**

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The Fairbanks Co.—Albany, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Hartford, Newark, New Orleans, New York, Philadelphia, Pittsburgh, Providence, St. Louis, Syracuse, Havana, London, Glasgow, Paris.

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Advertising is simply the searchlight of modern business. It brings your commodity before the buyer.

An advertisement in the RAILWAY MECHANICAL ENGINEER will seen by thousands of railway men who are striving for railway efficiency results.

Railway Mechanical Engineer

No Hunting Around for a Different Mandrel for Every Job

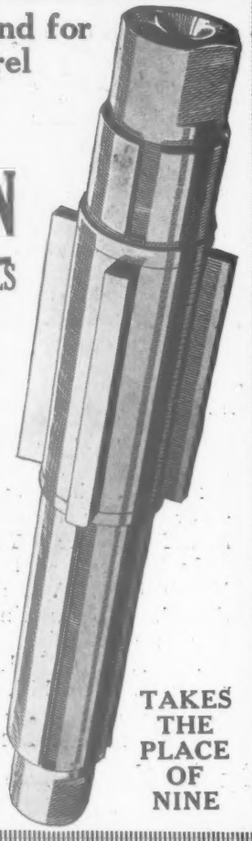
ONE SET OF NINE

NICHOLSON

EXPANDING MANDRELS

affords an instant fit for any hole — round or square — from one to seven inches. Quick to insert; quick to remove. Your machines will be producing every minute. Increased production simply has to follow, with greater accuracy. "Nicholsons" cannot distort. The jaws are always concentric.

Write now for free 30-day trial—there is no obligation involved.



TAKES THE PLACE OF NINE

W. H. NICHOLSON & CO.
118 OREGON ST.
WILKES BARRE, PA.

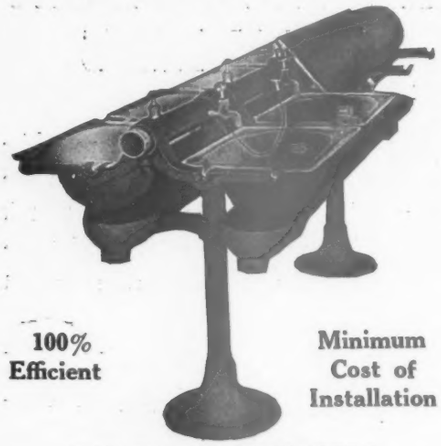
Helping Uncle Sam

That is what the man is doing shown in cut; he is helping Uncle Sam by doing a job alone with the help of a Canton Portable Crane—that would otherwise require several men to do.

Booklet G-53 shows why 50 railroads use the "Canton."

CANTON FOUNDRY & MACHINE CO.
Canton *"The Handiest Tool in the Shop"* Ohio

YOUR MEN WILL APPRECIATE A CLEAN PLACE TO WASH



100% Efficient

Minimum Cost of Installation

M. E. & E. CO. WASHBOWLS

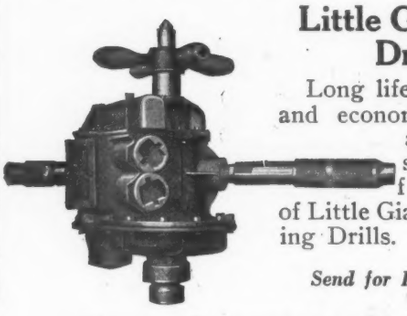
Every time each man uses M. E. & E. Co. Washbowls he is absolutely sure of a clean wash free from contamination.
M. E. & E. Co. Individual Washbowls are made for one or two temperatures of water, self-closing or compression bibbs, and in single and double batteries of any number. Any mechanic can make the simple pipe connections required.

SEND FOR OUR COMPLETE CATALOG

showing our line of Washbowls, Metal Lockers, All Steel Stools and Chairs with Inset Wood Seats, Stock and Storage Racks, Metal Shelving, Metal Vault Fixtures, Improved Soda Kettles, 40 and 60 gallons, Water Heaters and Instantaneous Mixers, Bubbling Drinking Fountains, Work Benches and Bench Legs, Drawing Stands, full lines of Plumbing Fixtures, etc.

Manufacturing Equipment and Engineering Co.
Office and Showrooms—Boston, Mass., U. S. A.
MAIL ADDRESS—Framingham, Mass., U. S. A.
See our advertisements in other issues. 2

CHICAGO PNEUMATIC TOOLS



Little Giant Air Drills

Long life, high power and economical upkeep and air consumption are features of Little Giant Ball Bearing Drills.

Send for Bulletin 127.

Boyer Pneumatic Hammers

have been standard in railroad shops for twenty-five years. They are made in three parts, cylinder, handle and valve—a construction which facilitates examination, cleaning and repairs and extends the life of the tool indefinitely.

Send for Bulletin 124.

We also manufacture Chicago Pneumatic Compressors, Duntley Electric Drills and Grinders and Giant Fuel Oil Engines.

Chicago Pneumatic Tool Company
1066 Fisher Bldg. Chicago
52 Vanderbilt Ave. New York
BRANCHES EVERYWHERE 3

Erie Foundry Co.

ERIE, PA.

U. S. A.

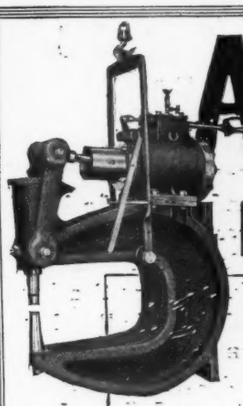
Builders of

"ERIE"
Single Frame Steam Forging Hammers

"ERIE"
Double Frame Steam Forging Hammers

"ERIE"
Steam Drop Hammers

For either air or steam operation. We are prepared to make reasonably prompt deliveries.



ALLEN Riveters

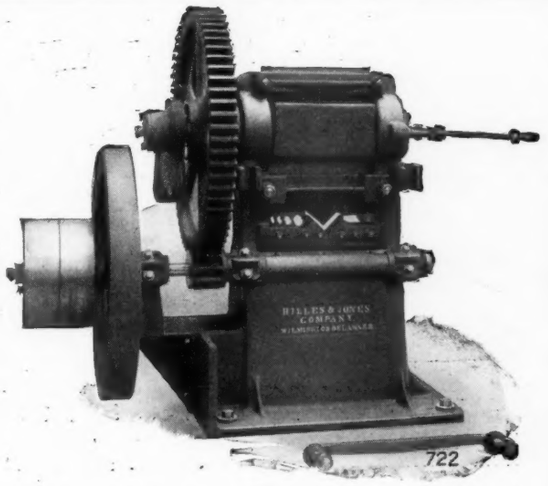
THERE is no other type of riveting equipment that will do as fast and tight work as the ALLEN machines.

Allen service is distinctly superior and dependable. If your shop is not Allen equipped you are missing a reduction of riveting costs as well.

Write for latest catalog with full particulars.

JOHN F. ALLEN CO.,
372 Gerard Ave. NEW YORK

"Whatever the Riveting there's an Allen for the Job"



Convenient Guillotine Shear

Angle, Flat, Square and Round Bars can be sheared without changing knives.

Made for any capacity. Belt or Motor drive. Increases production. Minimum floor space

Makers of a complete line of Punches, Shears, Plate Bending Rolls, Plate Straightening Rolls, Roller Levelers, Beam Copers, Rotary Bevel Shears, Plate Planers, Flanging Clamps, Angle Bar Planers, Plate Jogglers, Hydraulic Frame Jogglers, Rail Straighteners, Horizontal Benders, etc.

HILLES & JONES COMPANY
Established 1854

Pittsburgh Office:
235 Oliver Building

Wilmington, Del.

DUFF

Easiest Operating Car Box Jack Ever Designed

The hitherto impossible ease of operation which has been obtained in the Duff Improved Ball Bearing Journal Jack means something more than mere comfort to the user. The significance of the quick and easy response obtained under heavy loads, as well as under lighter ones, is that friction is an absent factor.

DUFF JOURNAL JACKS

The importance of this lack of friction cannot be over estimated, for where there is no friction, there can be no wear to speak of, and without wear upkeep becomes a question unnecessary to be considered. Only injury to the working parts through misuse will cause the Duff Improved Journal Jack to be sent to the repair shop. Lack of space makes it impossible to explain the construction of this Jack, but a Special Bulletin tells the story in full. Ask for it today.

The DUFF MANUFACTURING CO., Established 1883, Pittsburgh, Pa.

New York Chicago Atlanta St. Paul San Francisco

Spacing Tables Our Specialty

Let us send you all the facts and figures on our spacing tables. We are specialists in this work. Thomas Spacing Tables and Multiple Punches are known the world over.

Punches and Spacing Tables for the

Boiler Shop
Steel Car Shop
Tank Shop

Send us your requirements today.

Thomas Spacing Machine Co.
Pittsburgh, Pa.

WELDING

with

Alternating Current Electric Arc

Portable Guaranteed Machines

We have machines for all kinds of work, and can show economy over other systems. Our satisfied customers continue to send us repeat orders.

Recommended for the following work:

Boiler construction and repairs.
Ship construction and repairs.
Locomotive construction and repairs.
Tank manufacturing and repairs.
(Especially tanks requiring absolute tightness)
Pipe manufacturing and repairs.
(Especially the introduction of odd-shaped tees and branches)
Automobile construction and repairs.
Railroad line work and repairs.
Cutting of shell stock by nicking, and kindred uses.

Prompt Deliveries

Electric Arc Cutting & Welding Co.
222 Halsey Street, Newark, N. J.

PURER, more efficient oxygen and hydrogen at one third the cost—impossible, you say. Not at all. Service records show that I. O. C. Type 4-1000 Generators produce gases at least 25% more efficient, because of their purity, at a saving of at least 60% in cost. Let your decision be guided by facts—not by theories or promises.

Post yourself on
"The Cell with Three Times the Capacity Per Unit of Space"

INTERNATIONAL OXYGEN COMPANY
115 Broadway New York
Standardized Apparatus

You Could Not Use a Tack Hammer to Drive a Spike

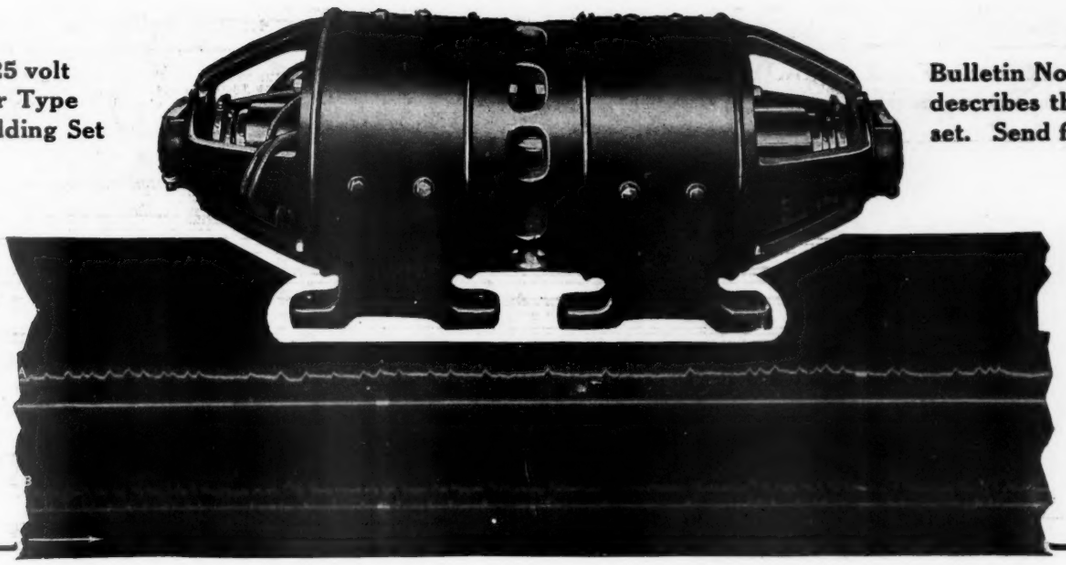
Certainly not, and the same reasoning should govern your selection of a welding process for heavy work. To attempt to weld heavy sections with the oxy-acetylene or electric process is just as absurd as attempting to drive a spike with a tack hammer. THERMIT is the only process that is fundamentally adapted to the welding of heavy sections, such as locomotive frames.

It will pay you to learn all about the Thermit welding process, and our new Pamphlet No. 2151 gives you just the information you need.

Write for a copy.

METAL AND THERMIT CORPORATION
The Equitable Building, 120 Broadway, New York.
7300 So. Chicago Ave., Chicago. 1427 Western Ave., Pittsburgh Pa.
329-333 Folsom St., San Francisco. 15 Emily St., Toronto, Can.

3 kw. 125 volt Balancer Type Arc Welding Set



Bulletin No. 48940 describes this set. Send for it

Oscillograph curve, showing electrical conditions in welding circuit of constant energy arc welding equipment. Curve "A" shows current in arc, approximate average value 150 amps. Curve "B" shows voltage across arc, approximate average value 15¾ volts.

Steady Flow of Metal Assured by Efficient and Simple G-E Welders

G-E constant energy arc welding sets are used to assure a steady flow of metal into the weld and high operating efficiency.

A constant flow of metal is assured by the inherent automatic regulation of the energy in the welding circuit throughout the welding range for metal electrodes.

The distribution of welding current between the two units comprising the set and practically dispensing with external resistance in series with arc, assure high efficiency.

One small panel and the set illustrated are all the equipment needed for a one-man outfit where operator has mask and electrode with flexible cable—if 125 volt direct current is available.

Consistently perfect welds are being produced in essential war industries by the use of this equipment.

We are prepared to demonstrate these sets and make good deliveries

43-88

General Electric Company

General Office Schenectady, N.Y.

Something New
in Hollow Staybolt Iron

Seamless—Made Without Welds

The First "Made in America" Seamless Hollow Iron

Will Not Split in Threading or Driving

ADVANTAGE OF A HOLLOW BOLT *with the* DURABILITY OF ULSTER SPECIAL

e from the original solid finished bar of identical Ulster Special ...t is standard for staybolts on majority of leading railroads—no change in process of its manufacture.

Self inspecting—Hole perfectly round and true.

Guaranteed not to split in threading or driving which increases output and reduces shop cost.

Will pass all railroad and other standard staybolt iron specifications.

Furnished in lengths and sizes used, saves time and cost of cutting, eliminates crop ends and facilitates handling.

Once tried the results will justify its continued use.

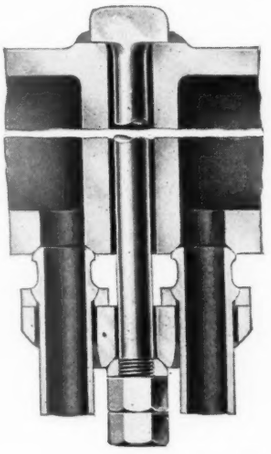
Further information, price, delivery, etc., will be furnished on request.

JOSEPH T. RYERSON & SON

CHICAGO NEW YORK ST. LOUIS DETROIT

SUPERHEATERS

MAINTENANCE and OPERATION



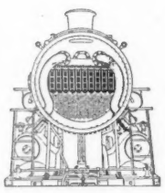
UNIT CLAMP BOLTS

In superheater locomotives the steam passes twice through the header. In the saturated state it passes from one compartment of the header to the units, where it becomes superheated, and returns from the units to the superheated compartment of the header, and thence to the cylinders. Each unit, therefore, has two joints with the header, and, bearing in mind that these joints are all located in the smokebox, the importance of their being always free from leaks will be evident.

Careful designing, based on experience, has provided a most satisfactory type of connection at this point. The units are made with ball shaped ends, which seat in 45° seats in the header, and are held in place by a clamp and a bolt for each unit. The bolts used are of heat-treated steel and have a tensile strength of 100,000 lbs. per square inch. Each bolt is fitted with two nuts capable of developing the full strength of the bolt.

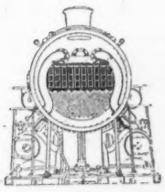
With correct workmanship on the ball ends and header seats, these bolts insure tight joints at all times. Bolts of low tensile strength will stretch under the action of a workman with a wrench in setting up the nuts and the joints will not be steam tight.

Bolts of high tensile strength, and with properly fitted nuts of equal strength, are insurance against steam leaks at the header and unit joint.

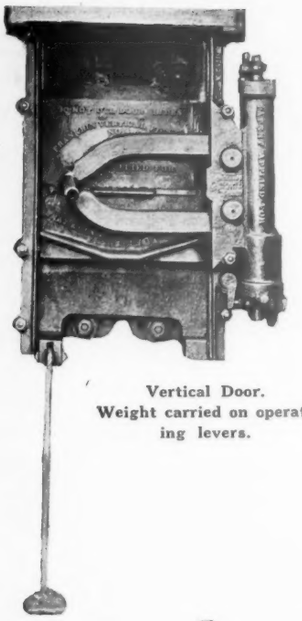


Locomotive Superheater Company

New York Chicago

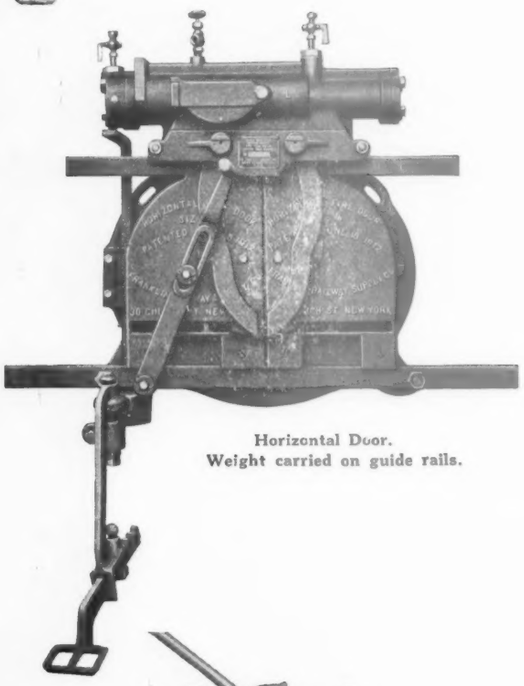


EVOLUTION OF THE FIRE DOOR



Vertical Door.
Weight carried on operating levers.

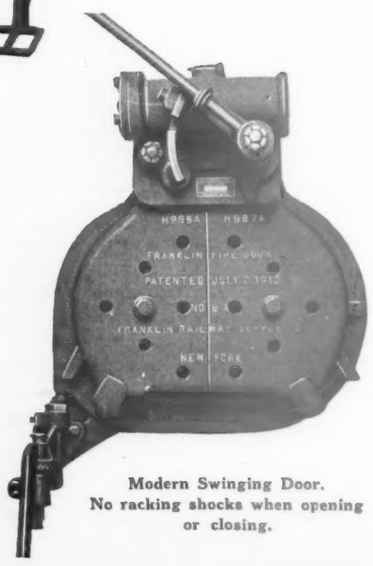
The Pioneer Door, designed in 1906—long since obsolete. Its crude lines have a "counterfeit" look when compared with our modern doors.



Horizontal Door.
Weight carried on guide rails.

A later type. Easier, smoother acting because the weight rolls on horizontal guide rods.

The Modern Door



Modern Swinging Door.
No racking shocks when opening or closing.

Door plates swing pendulum-like, from hardened pivots.

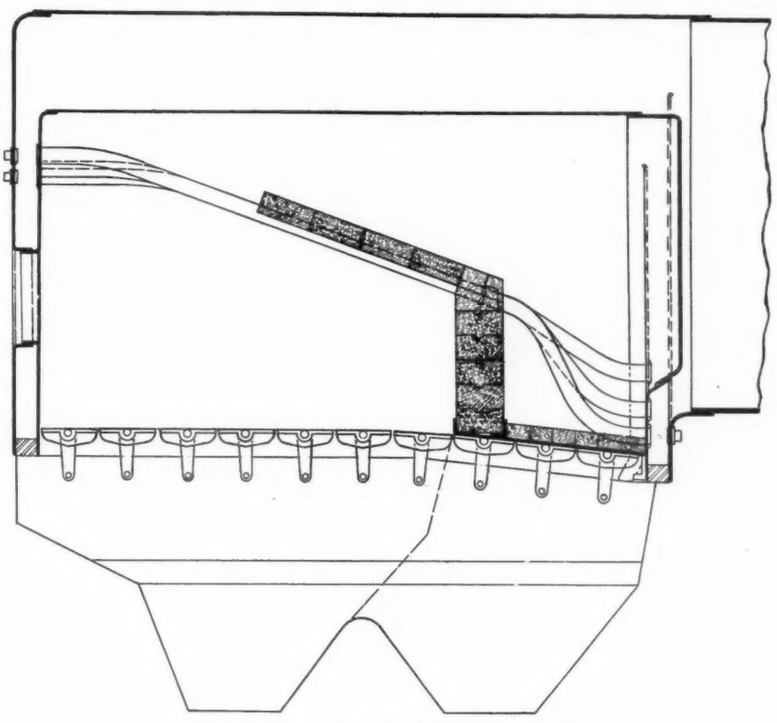
A pendulum swings for years without wearing out.

So does a modern Franklin Fire Door.

The first modern door applied has been in continuous service over six years.

Franklin Railway Supply Company, Inc.

RECONSTRUCTION



Combined Arch and Baffle Wall In Wide Firebox.

Hard coal burners because of their large grate area are extremely wasteful when fed soft coal.

To correct this, our Engineers designed a brick baffle wall and Arch combined.

This arrangement applied to hard coal burners has converted them into economical users of soft coal.

Such economies are demanded in the reconstruction period now upon us.

AMERICAN ARCH COMPANY

LOCOMOTIVE ENGINEERING DEVELOPMENT

Great as has been the recent advance in locomotive engineering only a small part of the potential possibilities of the steam locomotive has been realized.

In no field is the return so quick or so great as in developing the resources of the steam locomotive.

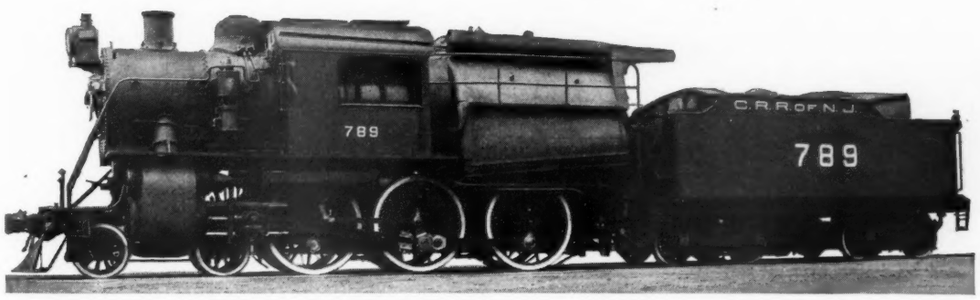
Lima is organized to help you in this great work.

Lima Locomotive Works, Incorporated

Lima, Ohio

30 Church Street New York

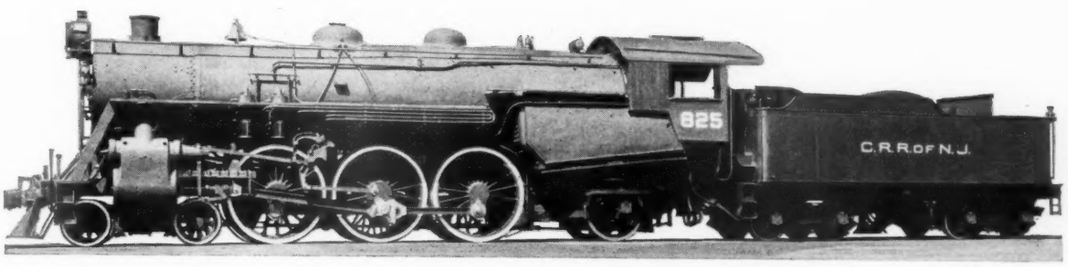
BALDWINS FOR THE NEW JERSEY CENTRAL



Ten-Wheeled Locomotive, Central R. R. of New Jersey.
C. E. Chambers, Supt. Motive Power.

CYLINDERS—23 x 28 inches.
DRIVING WHEELS, DIAM.—69 inches.
STEAM PRESSURE—220 lbs.
GRATE AREA—91.4 sq. ft.
WATER HEATING SURFACE—2,306 sq. ft.
SUPERHEATING SURFACE—477 sq. ft.
WEIGHT ON DRIVING WHEELS—170,800 lbs.
WEIGHT, TOTAL ENGINE—225,600 lbs.
TRACTIVE FORCE—40,200 lbs.

These locomotives are designed to burn either anthracite alone, or a mixture of anthracite and bituminous coal. The Ten-wheeler represents the latest development of a series of locomotives, first built in 1910, which have proved specially successful in fast freight service. The Pacific type locomotive, with larger driving-wheels and increased steaming capacity in proportion to adhesion, is fitted for heavy express passenger service.



Pacific Type Locomotive, Central R. R. of New Jersey.

CYLINDERS—26 x 28 inches.
DRIVING WHEELS, DIAM.—79 inches.
STEAM PRESSURE—210 lbs.
GRATE AREA—94.8 sq. ft.
WATER HEATING SURFACE—3,757 sq. ft.
SUPERHEATING SURFACE—816 sq. ft.
WEIGHT ON DRIVING WHEELS—181,400 lbs.
WEIGHT, TOTAL ENGINE—291,400 lbs.
TRACTIVE FORCE—42,800 lbs.

THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA, PA., U. S. A.

Represented by

F. W. Weston, 120 Broadway, New York, N. Y.
C. H. Peterson, 627 Railway Exchange, Chicago, Ill.
A. S. Goble, 1210 Boatmen's Bank Building, St. Louis, Mo.
G. F. Jones, 407 Travelers Building, Richmond, Va.
A. J. Beuter, 312 Northwestern Bank Building, Portland, Ore.
Williams, Dimond & Co., 310 Sansome Street, San Francisco, Cal.

Cable Address: "BALDWIN, PHILADELPHIA."

Lukens

OUR STAMP

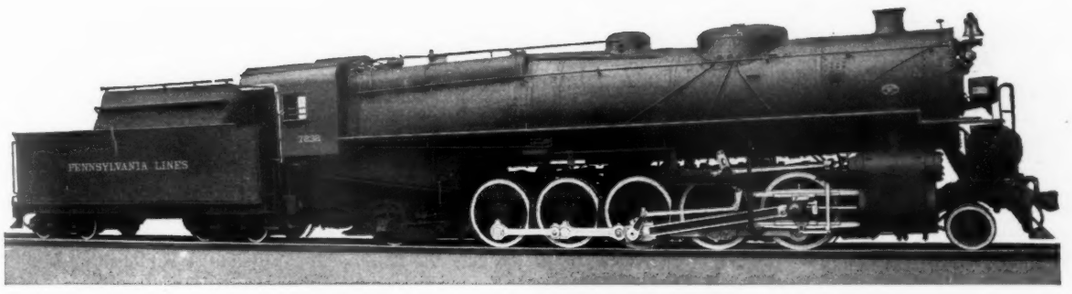
For over a century the Lukens Stamp on steel has stood for quality. It represents the continuous effort of this company to produce Locomotive Firebox and Boiler Steel of the very highest grade. That this ideal has been accomplished is evidenced by the fact that to all users throughout America

Lukens Signifies Quality

LUKENS STEEL CO.

Coatesville **Penna.**

POWERFUL LOCOMOTIVES



PENNSYLVANIA LINES WEST, 2-10-2 TYPE LOCOMOTIVE

Total Weight of Engine, 435,400 pounds; Weight on Drivers, 351,300; Diameter of Drivers, 62 inches; Boiler Pressure, 205 pounds; Cylinders 30 x 32 inches; Maximum Tractive Power, 81,000 pounds

Powerful locomotives of approved design are also the most economical. This fact is being more generally appreciated.

The Pennsylvania Lines West have taken advantage of the possibilities which the large 2-10-2 locomotive has to offer them.

The ultimate benefits which will result will certainly justify these engines to the fullest extent.

AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET, NEW YORK

King Metallic Packing

Valve stem and piston rod packing of the highest efficiency must combine heat resisting qualities with extreme strength and durability. Rugged construction and simplicity in design are necessary factors.

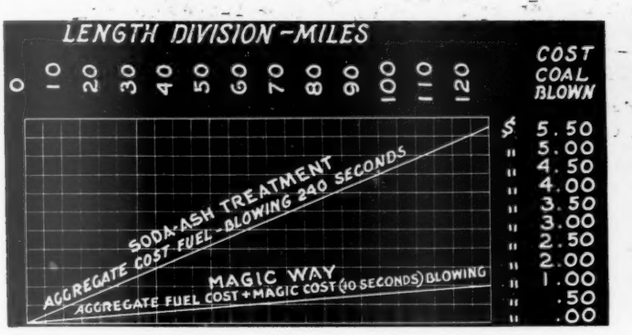
KING
Metallic Packing

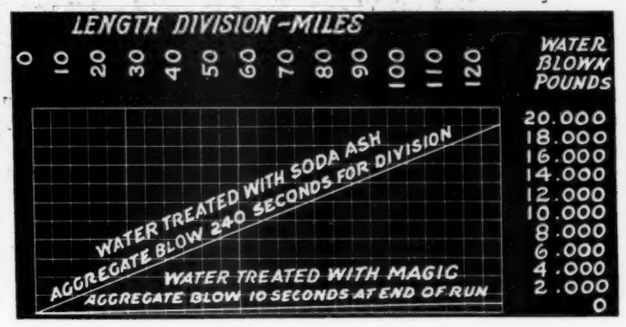
possesses these qualifications to a marked degree. Made in two parts only—The Ring interlocks when in position on the rod. King readily adapts itself to the varying and exacting conditions on railroads today.

The United States Metallic Packing Co.

Philadelphia, Pa.

Why Blow Your Coal Away?


LENGTH DIVISION-MILES
0 10 20 30 40 50 60 70 80 90 100 110 120
COST COAL BLOWN
$ 5.50 5.00 4.50 4.00 3.50 3.00 2.50 2.00 1.00 .50 .00
SODA-ASH TREATMENT
AGGREGATE COST FUEL-BLOWING 240 SECONDS
MAGIC WAY
AGGREGATE FUEL COST + MAGIC COST (10 SECONDS) BLOWING


LENGTH DIVISION-MILES
0 10 20 30 40 50 60 70 80 90 100 110 120
WATER BLOWN POUNDS
20.000 18.000 16.000 14.000 12.000 10.000 8.000 6.000 4.000 2.000 0
WATER TREATED WITH SODA ASH
AGGREGATE BLOW 240 SECONDS FOR DIVISION
WATER TREATED WITH MAGIC
AGGREGATE BLOW 10 SECONDS AT END OF RUN

The above charts represent blowing of boilers through 1½" blowoff cock 200 lbs. pressure, water treated with Soda Ash as against MAGIC Boiler Preservative showing saving in coal due to loss by the use of road blowing of engines. Note instructions in the use of "Magic" in regard to blowing.

Instructions

Road blowing should be avoided unless absolutely necessary, and then short blows not to exceed five (5) seconds are recommended.

A blow of five (5) seconds at the time of cleaning fires at the end of a run is suggested.

Carefully compiled data is ready for your request.

Address inquiries to Railroad Department of

GARRATT-CALLAHAN CO.

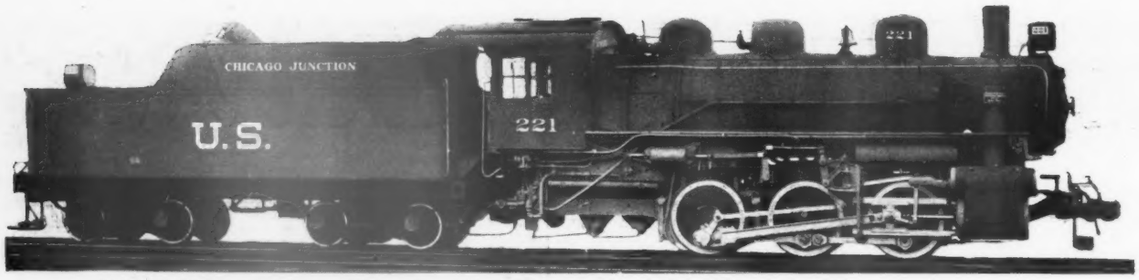
Sole Manufacturers, Distributors and Patentees of Magic Boiler Preservative

30-32 Fremont Street
San Francisco, Cal.

27 So. Clinton Street
Chicago, Ill.

MAGIC BOILER Preservative

Copyright by The Garratt-Callahan Co., 1918.



United States Railway Administration Standardized Six Wheel Switcher Equipped with Slope Sheet Coal Pusher

Mechanical Coal Pushers

For Switching Locomotives and
Light Passenger Locomotives

Duplex Stokers

For Heavy Road Engines

The many economies resulting from the use of these labor saving devices recommend them for old as well as for new locomotives

Locomotive Stoker Company

Main Office and Works, Pittsburgh, Pa.

Railway Exchange
Chicago

50 Church St.
New York

The Greatest Mother in the World

Red Cross contributions, frequent and generous, are our bounden duty. They insure to us here in our comfortable homes a security dearly bought by our soldiers, battered, bruised and bleeding, over there in the battle-torn lines of the World's greatest fight for civilization, home and family. Therefore, we must give, give and give again—give on every call. It's for him and the "Greatest Mother in the World."

Westinghouse Air Brake Co.

General Office and Works, Wilmerding, Pa.

Atlanta, Ga.			San Francisco.
Boston, Mass.	Denver, Col.	Mexico City	Seattle. Wash.
Chicago, Ill.	Houston, Tex.	New York. N. Y.	St. Louis, Mo.
Columbus, O	Los Angeles Cal.	Pittsburgh, Pa.	St. Paul, Minn.

Here is What Stopped Our Epidemic of Hot Pins

The rod gang foreman was speaking reminiscently about engine failures, particularly of hot pins and the epidemic of failure they had caused on his road—an important trunk line—when everybody, from the President down had "Got busy."

Pointing at a pile of

Gilbert
Velox Phosphor Bronze

rod brasses he said: "Here is what stopped our epidemic of hot pins."

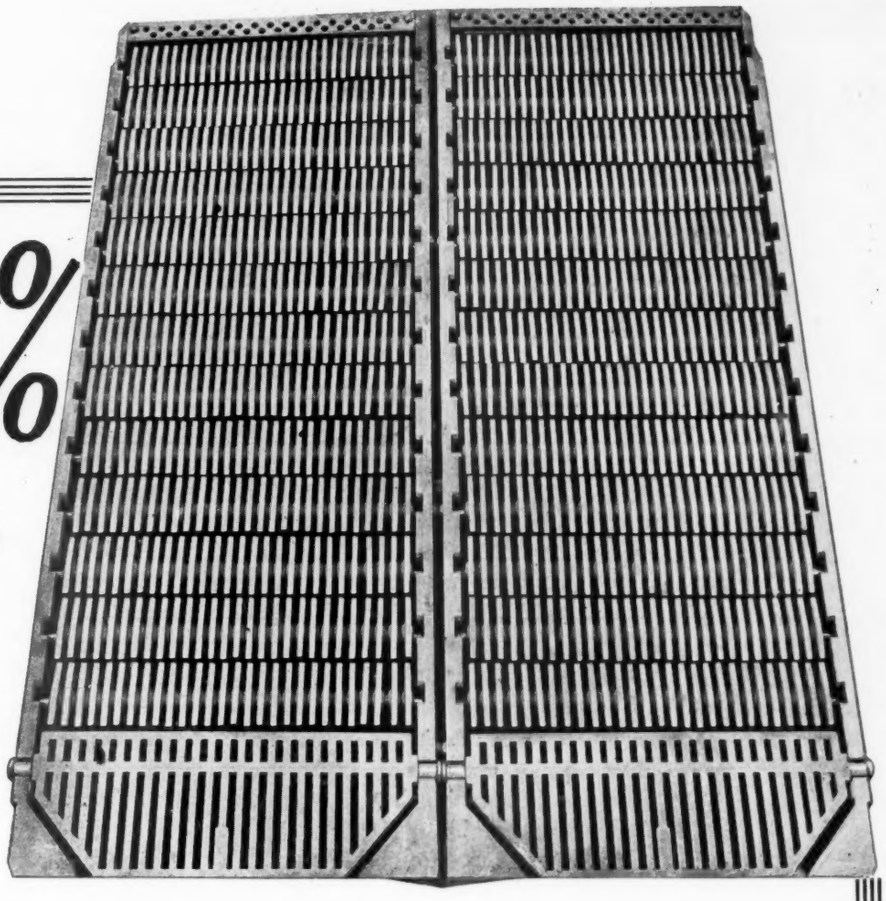
For rod brasses—driving boxes—and, in short, every important point where a bearing is required, Velox Phosphor bronze is well worth considering.

Years of careful scientific research based on a thorough knowledge of railroad requirements has enabled us to develop a bearing metal offering the least frictional resistance—and combining all the essential elements necessary for durability, strength and long life.

For service peculiarly free from the endless troubles due to faulty bearings—Velox Phosphor Bronze is particularly adapted.

If you are not now using it, let us talk it over. A card will do—mail it today.

A. Gilbert & Sons Brass Foundry Co.
St. Louis, Mo.



55%

of the
Heating Surface
of the
Hulson
Locomotive
Grate
is made up of

AIR OPENINGS

between the fingers and around the sides and ends of the grate. This is about 25 per cent more air space than is afforded by grates of the ordinary type.

Plenty of oxygen is one of the necessities to free combustion. It is better to admit it freely through the grate than to be obliged to use an exhaust nozzle so small that it is continually tearing holes in the fire.

Because of this amount of free space for the passage of air it has been found possible where the Hulson Grate is in use to enlarge the exhaust nozzle opening. Every master mechanic and superintendent of motive power knows what this means in keeping the fire in good condition and in heading off the run on the coal pile.

Yet, there is no chance for wasting unconsumed coal through the grate, because there are only 5/8-inch openings between the fingers. There are 728 of these fingers in the illustration shown.

Because of the large number and small size of the openings air is distributed exactly as it ought to be to promote perfect combustion—that is, all over the grate surface.

Hulson Grate Company
Keokuk, Iowa, U.S.A.

"NATIONAL" PIPE *for*

THE uses of "NATIONAL" Pipe cover a field so wide that to compile a list of them would be practically impossible. Such a list could never be considered as complete, for new uses are being found every day. However, for the purpose of conveying an idea of the diversity of uses of "NATIONAL" Pipe, it may be stated that there are practically no branches of commerce or industry in which it does not serve, in one or another of its many types.

THE full significance of this statement is best appreciated by taking into consideration that for many years the only use for pipe was that of a conductor for fluids, gases, etc.; that in the early history of pipe, men were chiefly concerned with improving the material for these fundamental uses rather than for new applications; and that the requirements of the times were neither so complex nor exacting as those of today. This is the age of inventiveness, of constructive thinking, of speed and efficiency. Economy of design marks every new mechanical construction. Dead wood must be eliminated to make room for the highly developed apparatus now required to meet the needs of a highly organized society. Mere bulk must give way to efficiency.

"NATIONAL" Pipe is doing its full share in this connection; as a material for mechanical construction, it has proved ideal. Because of its uniformity and great strength, coupled with minimum cross-section, it is used in places where heretofore solid metal stock was considered indispensable, or in places where metallic or wooden material could not be used at all because of excessive weight or bulk. "NATIONAL" Pipe has also been found adaptable to many mechanical constructions on account of its unique ductility; this advantage permits bending, coiling, flattening and other manipulations—thereby doing away with special fabricating, fittings, etc., and resulting in neat, workmanlike appearance.

NATIONAL TUBE COMPANY

DISTRICT SALES OFFICES

Atlanta, Boston, Chicago, Denver, New Orleans, New York, Philadelphia, Pittsburgh, Salt Lake City, St. Louis, St. Paul

MECHANICAL PURPOSES

It pays to be NATIONALly Prepared

OTHER advantages which make "NATIONAL" pipe adaptable to a wide variety of mechanical constructions are: Sound welds, good strong threads (easily cut), smooth, clean finish for the application of enamels, bronzes, paints, etc., exceptional resistance to column and beam stresses, complete line of sizes and types, etc. etc.

FROM a supporting column in a large industrial or commercial building to a small connecting link of eighth-inch pipe; from the shell of a heating drum to the hand rails and other safeguards of shop or power plant; from the masts and booms of a large derrick to the shovel handles of a work crew, "NATIONAL" Pipe will be found giving a full measure of dependable service.

IN fact, "NATIONAL" Pipe Service is so flexible that it meets practically every wrought tubular requirement at present, and past records indicate that it is broad enough to anticipate many future needs.

EXPERIENCE has so impressed many consumers of the value of "NATIONAL" advantages that the word "NATIONAL" has become synonymous in their minds for "pipe quality." Therefore, when they wanted good pipe for any wrought tubular purpose they specified and insisted upon "NATIONAL," for they *knew* that

"NATIONAL"

IS THE CONSUMER'S GUARANTEE OF QUALITY

(General Sales Offices FRICK BUILDING) **PITTSBURGH, PA.**

PACIFIC COAST REPRESENTATIVES: U. S. Steel Products Co., San Francisco, Los Angeles, Portland, Seattle

EXPORT REPRESENTATIVES: U. S. Steel Products Co., New York City.

Uses in the Shop for

DIXON'S

Graphite Pipe Joint Compound

FOR LOCOMOTIVES

Air Pumpheads, Tops, Bottoms and Centerplates
Air Pump Starting Valves
Boiler Check Caps
Bolts thru Oak End Sills
Blower Valves
Blowout Cocks
Coldwater Fittings
Cylinder Head Studs and Joints
Dome Cap Bolts and Joints
Facing Gaskets
Flexible Stay Bolt Nut Caps
Glass Gauge Valves
Gauge Cocks
Injector Steam Pipes
Smoke Box Bolts, Front Ends
Steam Chest Bolts
Steam Pipe Fittings
Superheater Unit Connections
Surface Cocks
Washout Boiler Plugs and Plates

MISCELLANEOUS USES

Hydraulic Jacks
Pipe Fittings, Passenger Cars
Radiator, Air and Steam
Ram Plugs
Regulating Valves
Steam End Valves

Dixon's Graphite Pipe Joint Compound makes tighter joints for steam, water, air and oil piping than other material. It resists heat, cold, acids and alkalies, and protects the threads from corrosion of every sort. It never "sets" as red lead does; joints may be unscrewed at any time with ease, and without injury to pipe, fittings or tools.

As joints are screwed up, it is thoroughly distributed over the surface of the threads, filling in all the "chinks" forming a smooth, impervious coating of lubricant and rust-preventive.

DIRECTIONS

For pipe joints, apply with brush or swab. For bolts and screws it is better to use a swab where possible, and smear the Compound around the hole, as then the bolt or screw receives a better coating.

Stir well before using. If package is kept open and unused, cover the surface of the Compound with water or oil to prevent drying. Then, should lumps occur, soften by the addition of linseed oil.

Send for Booklet No. 105-D.

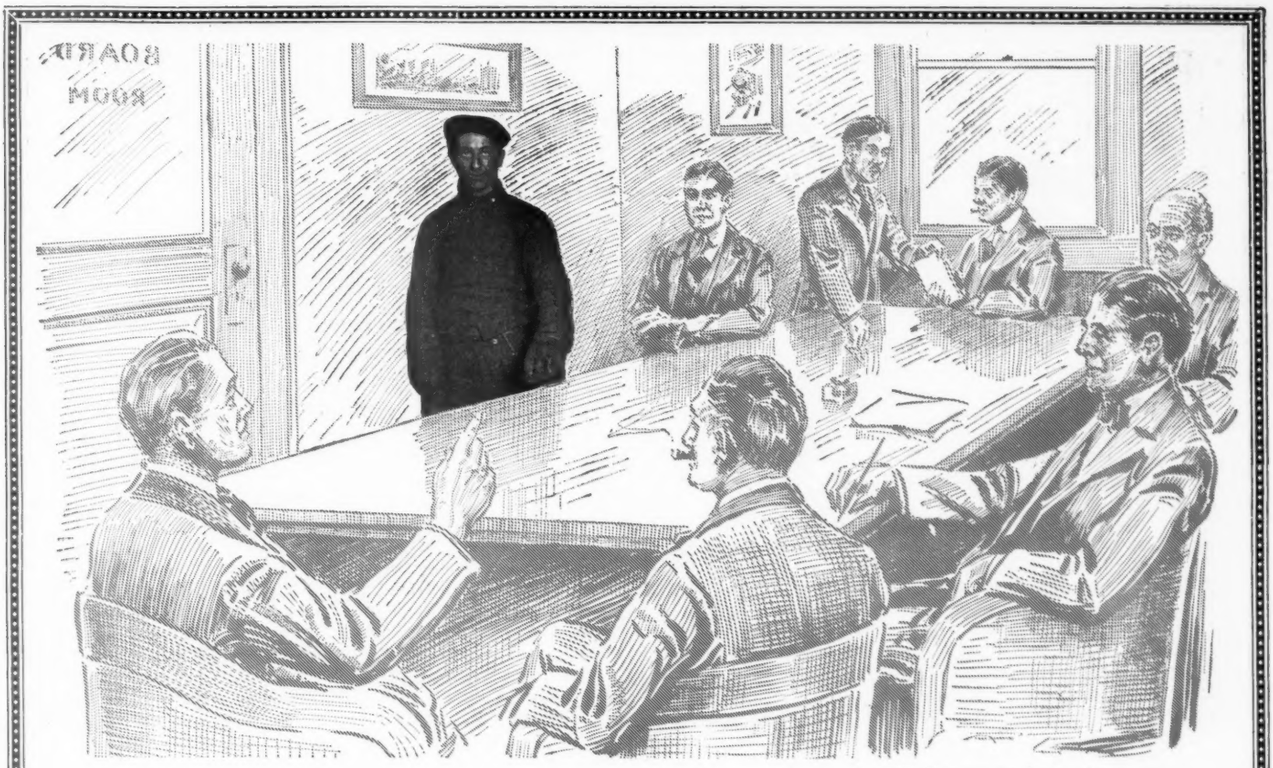
Made in Jersey City, N. J., by the

JOSEPH DIXON CRUCIBLE COMPANY

D X N TRADE MARK

Established 1827

D X N TRADE MARK



How *"Texas"* Jones Convinced The Railways

"TEXAS" JONES' REPORT

I MENTIONED that the Board decided to devote another session to lubricants for car journals. They realized from the start the importance of good lubrication, and seem to realize better every session that good lubrication and "Texaco" are homogeneous.

You remember "Pop" Smith's testimony about changing his underwear? I had a "hunch" they would seek some information concerning the difference between "Texaco Car Oil Winter" and "Texaco Car Oil Summer," so I got a car repairer from "Pop's" Branch for my expert.

My hunch proved true. "What lubricant do you now use on your car journals?" they asked him.

"Texaco Car Oil Winter, Sir." "We've been using it six months, but we'll soon change."

"Oh! you will," said the Chairman, sarcastic like, "may I ask what you will change to?"

"Texaco Car Oil Summer," came the answer. "We change 'em just as we do our underwear, and—"

"Yes! Yes!" said the Chairman quickly. "What is the difference between them?"

My expert scratched his head, and I stood up. "Mr. Chairman," I said, "the 'Summer' is a heavy bodied fine oil, an unusually good lubricant, very economical, and made for use except in cold weather."

"Is it used extensively?" said the Chairman.

"No! sparingly," said my expert, "I don't use nearly as much of it as I did of other lubricants."

"Indeed," said the Chairman, "how about the Winter Oil?"

"It has a medium body," I replied, "a very low cold test, and very fine lubricating qualities. It is specially compounded, and should not be used for the lubrication of bearings other than those specified, and—"

"Should be used by every railway during cold weather," added my expert.

Next month the testimony of "Prof." O'Brien, an authority on Driving Journal Lubrication, will be reported here. Don't fail to read it.

THE TEXAS COMPANY

Railway Sales Department

NEW YORK: Whitehall Bldg.
CHICAGO: McCormick Bldg.
ATLANTA: Healey Bldg.
HOUSTON: The Texas Co. Bldg.

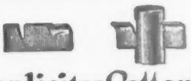
"There is a Texaco Lubricant for Every Purpose"

Columbia Devices to Keep Cars Moving

Columbia Lock Nut

Columbia Gib Nut

Columbia Castle Nut



Simplicity Cotter Key

Locked Clevis & Turnbuckle

Cold Pressed Nuts

USE A "COLUMBIA"— IT STAYS

Front end main rod keys held in place by a "nut" means that much depends on that "nut."

Is there a more important place on a locomotive—is there any other place where the staying power of a nut prevents much damage from "pound"?

A "Columbia" castellated nut at this one point provides for easy adjustment of front end brasses. A slight adjustment of the key saves "pound." This slight adjustment may mean only one-sixth turn of the nut—it makes no difference with the "Columbia" castellated nut. One-sixth or one-half turn and you always have full opening for the cotter pin.

A castellated nut takes the place of two ordinary nuts at this point. A castellated nut is more dependable and permits of a wider range of adjustment.

Let's get together on your "nut" problems. Ask us for descriptive catalog that shows the "how" and "why."

Columbia Nut & Bolt Company, Inc.

Bridgeport Connecticut

THE FINAL TOUCH

TO YOUR MOTIVE POWER

The electricians are putting the final touches to the first of 1,000

Sunbeam
U. S. Standard
Electric Headlights

to be applied by one of America's largest railroads.

This large railroad adopted the Sunbeam because it wanted to obtain headlight equipment of utmost simplicity—because it wanted to reduce headlight inspection and repair expense to a minimum.

The big features of the Sunbeam equipment are interchangeability and accessibility of working parts. The Sunbeam Turbo-Generator, Type RE-3, is of simple construction — low steam consumption — positive governor regulation—ball bearing—foolproof—dustproof. Pattern No. 1030 headlight is the U. S. Standard interchangeable headlight. Made entirely of steel except goggle hinge which is of malleable iron. The whole is electrically welded into one rigid piece. Reflector, focusing device, etc., are the result of 30 years' headlight experience.

The superheater, power reverse gear and other devices have modernized locomotive equipment. The final touch to your motive power is the Sunbeam Electric Headlight.

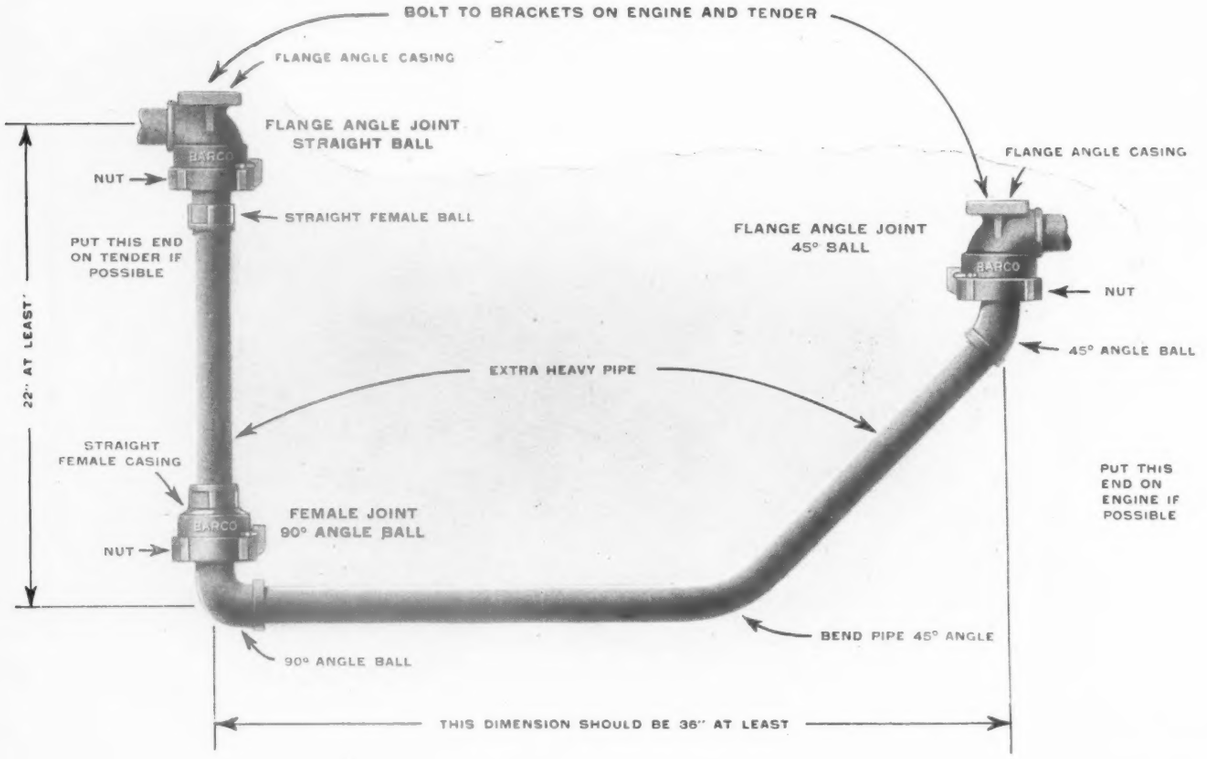
Pattern No. 1030 *"Welded of Course."*

Forty railroad systems use and endorse the Sunbeam. Our new Bulletin No. 42 tells why. May we send a copy?

SCHROEDER HEADLIGHT & GENERATOR CO.
EVANSVILLE INDIANA U. S. A.
AMERICA'S FOREMOST HEADLIGHT BUILDERS FOR 30 YEARS

BRANCH OFFICES:
NEW YORK 50 Church Street CHICAGO 20 E. Jackson Blvd. ST. LOUIS 214 N. Sixth St.

Suggestions for Maintenance on Government Standard Engines of Barco 3-V Type E T Connections



BARCO joints are widely used by the Railroads, and many of the Government engines equipped with our 3-V type air and steam connections between engine and tender will be in the hands of men entirely familiar with what little care or maintenance they require. The picture above with the names of parts will be helpful, however.

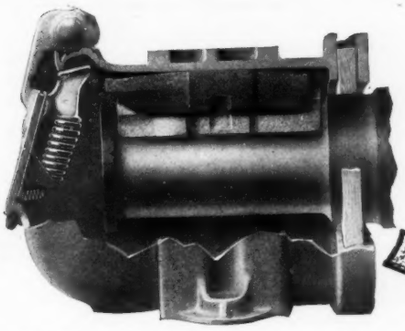
Standard pipe dimensions and location should be maintained under all conditions and can be with proper draw bar maintenance. Tighten nuts until gasket and ball are in contact, but movement is not stiff. Keep lock spring on nuts in use. All joints should be lubricated when tank is removed from engine or engine is in back shop.

Worn gaskets should be renewed promptly.

Specify iron pipe, size and name of part in ordering repairs.

Catalogues and instruction sheets on request.

Barco Manufacturing Co.
212 West Illinois Street Chicago, Ill.



The National Coiled Spring Journal Box

For Freight, Passenger or Tender Service,

Combines Strength and Durability with Lightness and Simplicity.

STRONG: Because well designed, and cast in one piece.

DURABLE: Because made of high grade Malleable Iron.

LIGHT: Because metal is properly distributed.

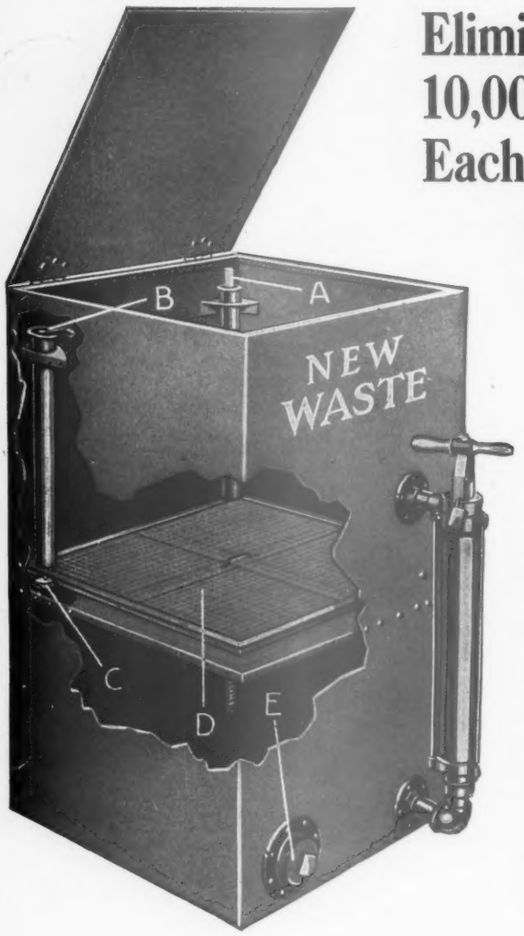
SIMPLE: Because fewest number of parts possible are used to obtain the desired results; Reliability of action and Ease of operation.

THE NATIONAL MALLEABLE CASTINGS CO.

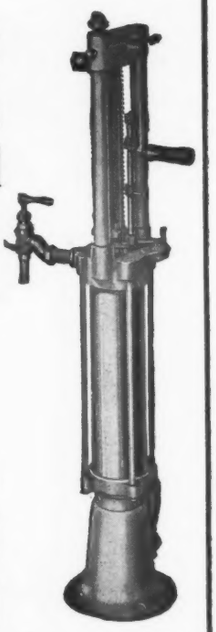
CLEVELAND CHICAGO INDIANAPOLIS TOLEDO
SHARON, PA. MELROSE PARK, ILL.

KEEPS THE OIL INSIDE

KEEPS THE DUST OUTSIDE

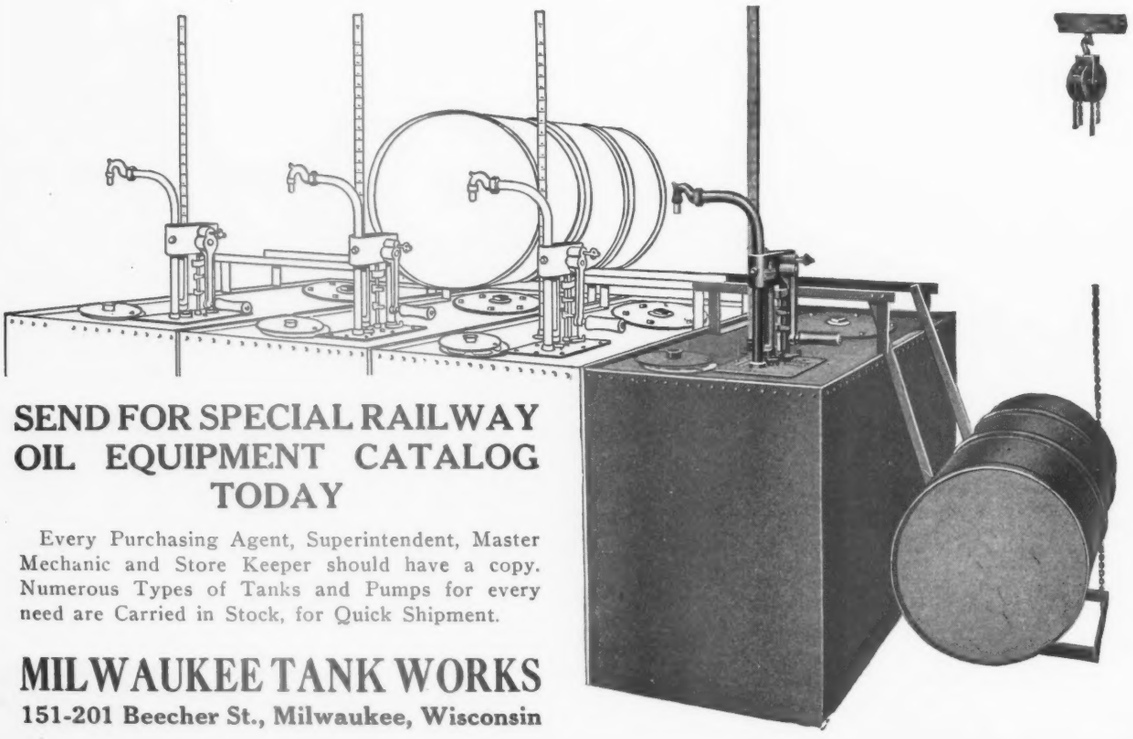


Eliminate Hot-Boxes, Get 10,000 to 20,000 Miles on Each Journal Packing, and Save a Third of the Oil by Using Milwaukee Waste Saturating Outfits



Self - measuring Pump, for drawing Oils, etc., from Underground or Basement Tanks. Made in 5 gal., 1 gal. and half gal. strokes.

24 Hours of Immersing in Oil, and 24 Hours of Draining off the Very Last Drop of Superfluous Oil, leaves the Cotton Waste Perfect for Journal Packing. Its innermost fibre is permeated with Oil, None wasted, and Results will Surprise you. Railway men say the Outfit pays for itself in from TEN TO THIRTY DAYS. Send for special Bulletin today. One outfit sufficient to hold packing for twenty cars every two days costs less than a hundred dollars.



SEND FOR SPECIAL RAILWAY OIL EQUIPMENT CATALOG TODAY

Every Purchasing Agent, Superintendent, Master Mechanic and Store Keeper should have a copy. Numerous Types of Tanks and Pumps for every need are Carried in Stock, for Quick Shipment.

MILWAUKEE TANK WORKS

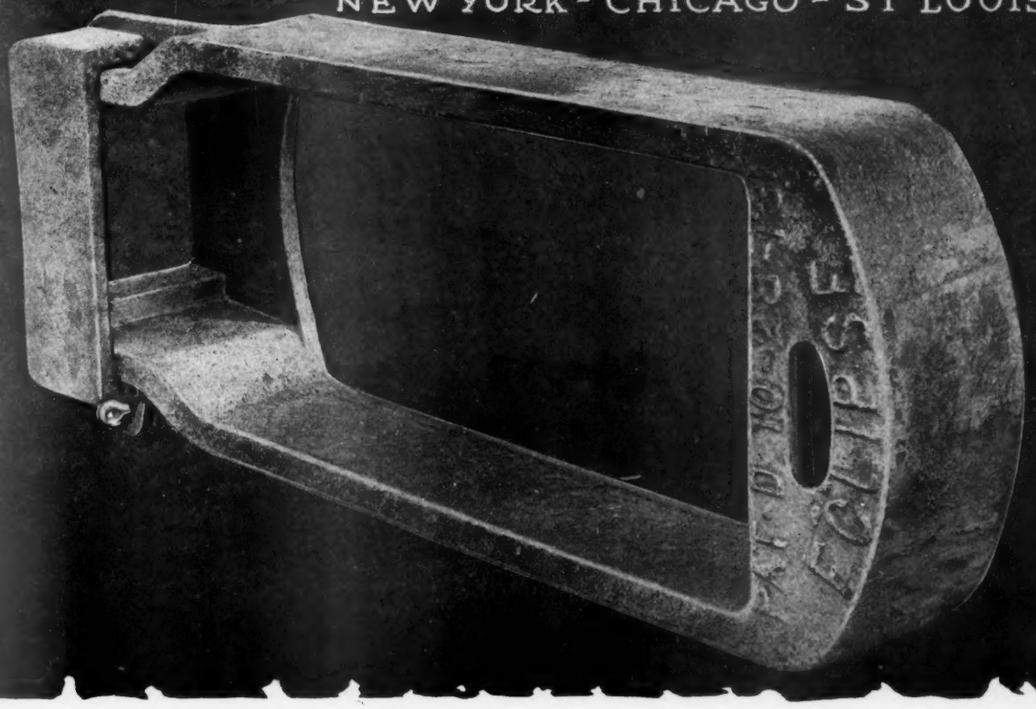
151-201 Beecher St., Milwaukee, Wisconsin

ECLIPSE
CAST STEEL COUPLER YOKE

To remove the coupler, simply take out the cotter and slide off the binder.

AMERICAN STEEL FOUNDRIES

NEW YORK - CHICAGO - ST LOUIS



THE PENN COUPLER

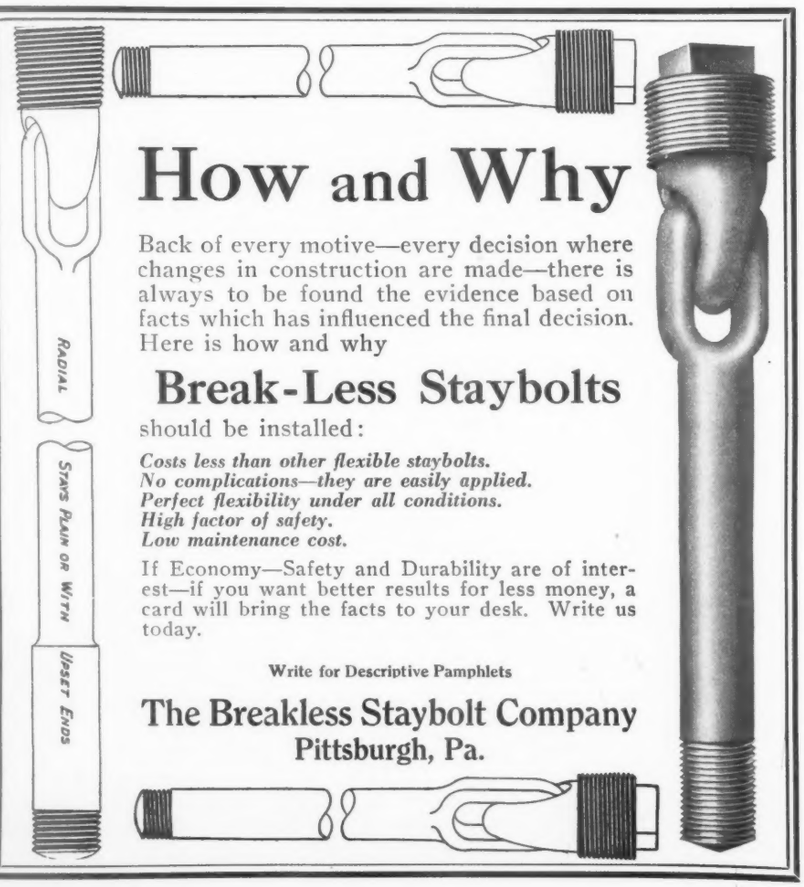
Our latest development of the M. C. B. Coupler, a modification of our popular Pitt and Janney X Couplers, with latest improvements.

Lock-To-The-Lock
Lock-Set and
Knuckle-Opener

Send for blueprints and prices.

Manufactured only by

THE McCONWAY & TORLEY CO.
PITTSBURGH, PA.



How and Why

Back of every motive—every decision where changes in construction are made—there is always to be found the evidence based on facts which has influenced the final decision. Here is how and why

Break-Less Staybolts

should be installed:

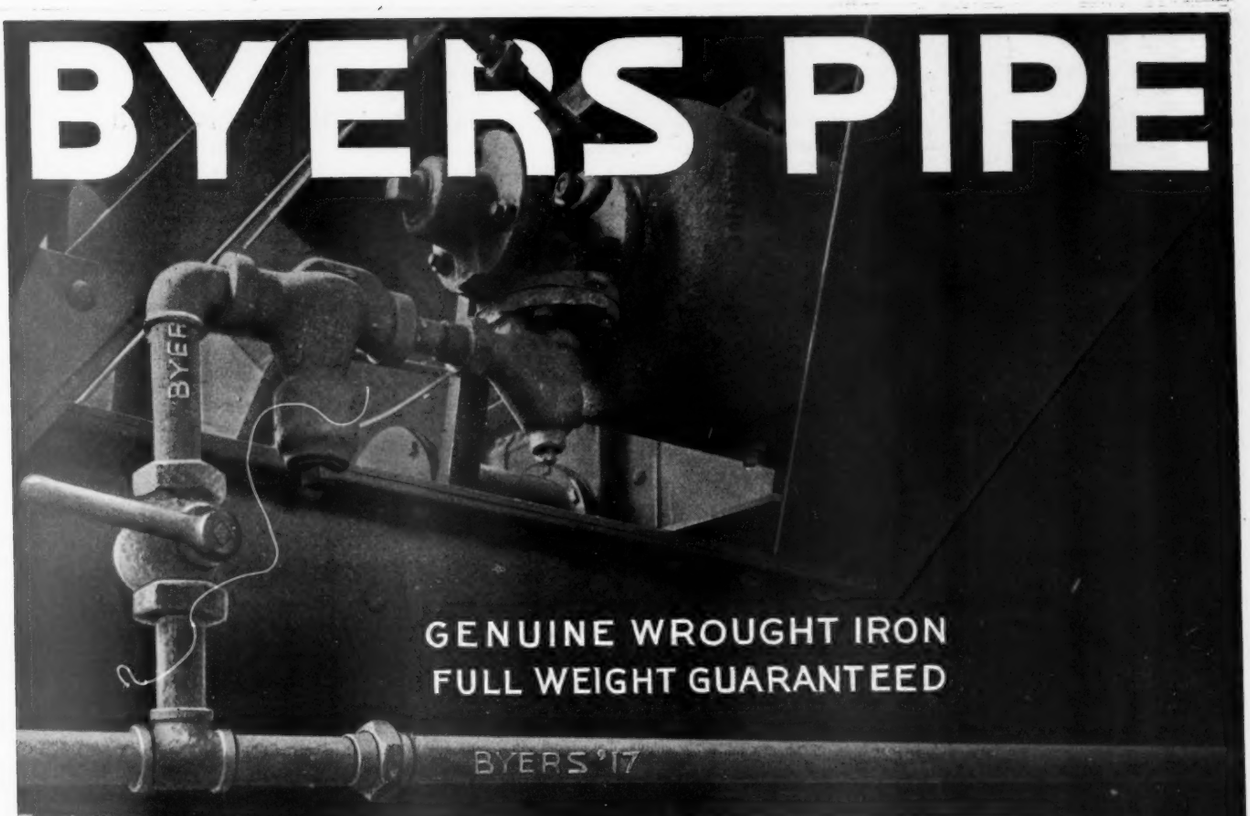
Costs less than other flexible staybolts.
No complications—they are easily applied.
Perfect flexibility under all conditions.
High factor of safety.
Low maintenance cost.

If Economy—Safety and Durability are of interest—if you want better results for less money, a card will bring the facts to your desk. Write us today.

Write for Descriptive Pamphlets

The Breakless Staybolt Company
Pittsburgh, Pa.

BYERS PIPE



Saves Air—
—and Money

FIGURES presented to the M. C. B. Association show that air line leaks, each in itself small, in the aggregate often equal in five minutes, on a long train, the amount of air required for a full service application—*twelve full service applications every hour the train is operated!* Also, with coal at the pre-war price of $2.00 per ton, it has been estimated that the cost of pumping against a six-pound leakage on an 80-car train, amounts to $9.60 every 24 hours.

These losses are partly due to the use of inferior piping and to leaky hose, couplings and fittings. There can be no questioning the statement that losses directly due to inferior piping are very considerable.

Byers genuine wrought iron pipe is used exclusively by a number of railroads for air lines. Its protective slag filaments resist the action of corrosive agents and insure long life. Its fibrous structure prevents crystallization and enables it to withstand the shocks and severe physical stresses of railroad service. Its clean cut, uniform threads make permanently tight joints.

Ask for literature describing "Four Easy Ways to Tell the Difference between Iron and Steel Pipe"

A. M. BYERS COMPANY

Established 1864

PITTSBURGH, PA.

New York Boston Chicago Dallas

Have you received a copy of Booklet

"STAYBOLTS"

A Bi-Monthly Digest

This book contains some very interesting data on the subject of Flexible Staybolts.

Write for a copy—it is free

1

The Detroit Automatic Flange Oiler

(Pendulum Type)

Protect Your Engine Against Unnecessary Loss of Service

The time has arrived when you will need every engine. It is a proven fact that efficient flange lubrication means decreased flange wear and greater tire mileage. Hence, engines are in revenue service longer periods between shoppings.

DETROIT AUTOMATIC FLANGE OILER
(Pendulum Type)

insures longer life to your tires. The "Detroit" can be applied to any locomotive. It requires no attention from the engineer and works independently of air or steam pressure. Switching power with good flanges saves time and accidents. Switch engine shown below has seen seven months' service, both day and night, and flanges are in perfect condition.

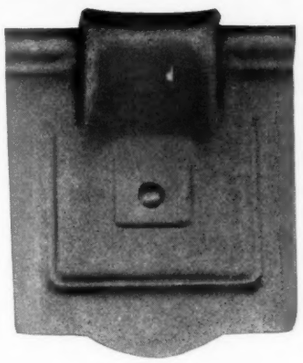
DETROIT LUBRICATOR CO.

DETROIT, U. S. A.

Largest Manufacturers of Lubricating Devices in the World.

PRESSED STEEL PARTS

JOURNAL BOX LIDS **TRUCK SPRING PLATES**



OUR SPECIALTIES

Press Capacity up to 1200 tons. Blanked and formed parts up to 1¼" in thickness.

Shipments from Stock

We are equipped to take care of your requirements as our own mills keep us supplied with Raw Materials

Send Us Your Inquiries

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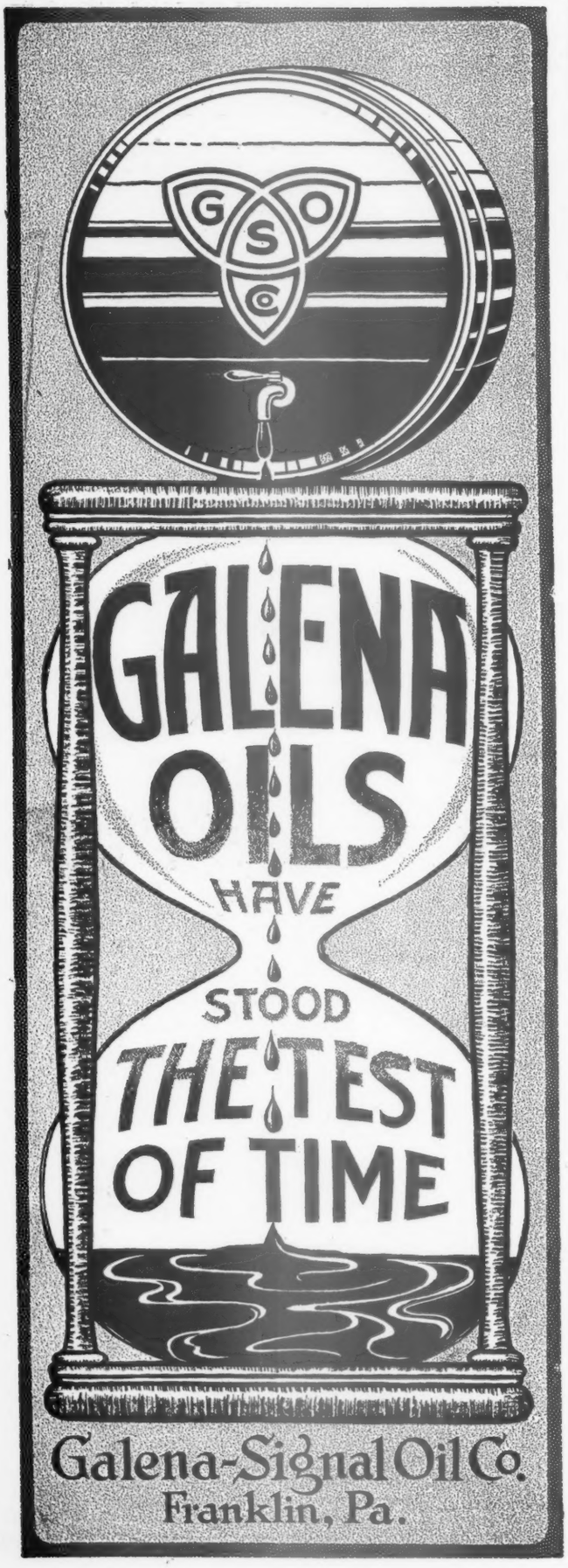
ARCH TUBE CLEANERS

THIS cleaner is used for 175 clean-outs every month. It has the "go" and the staying power. It's never out of order. The men like it. *It does the best work.* Of course, it's a *Lagonda.*

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO
FUEL SAVING SPECIALISTS

Makers of Lagonda Tube Cleaners, Tube Cutters, Automatic Valves, Grease Extractors. 407



Purchasing Agents!
Master Mechanics!
Car Superintendents!

And every other man who is interested in keeping the rolling stock of your road in constant service, are all interested in

"GRISCO"

A HOT BOX COMPOUND THAT ABSOLUTELY DOES AWAY WITH ALL NECESSITY FOR SETTING CARS OUT OF TRAINS.

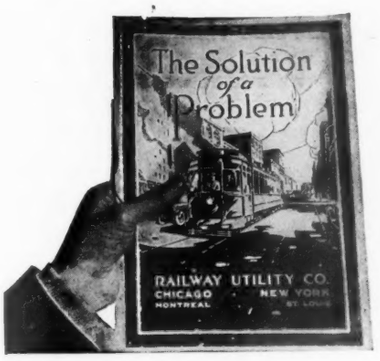
With a can of GRISCO as a part of a train's equipment, any hot box—**even a flaming one**—can be treated in five minutes, left in the train, and by the time you get to the next stop you can put your hand on the hot journal.

GRISCO contains no graphite or injurious acids.

THIS HAS BEEN PROVEN AND IS BEING PROVEN EVERY DAY ON TRAINS GRISCO-EQUIPT.

Write us TODAY for further information

GILL RAILWAY SUPPLY CO.
PEORIA ILLINOIS



Railroads desiring the most practical solution of their ventilation problems will find this booklet of decided value to them.

It contains a fund of information, with micro-photographs, test data, charts, formulae, etc.

Sent on Request

Railway Utility Company
151 W. 22nd St., Chicago

Vapor Car Heating Co., Inc.

Railway Exchange, Chicago

Successor to
CHICAGO CAR HEATING CO.
STANDARD HEAT & VENTILATION CO., Inc.

HEATING AND VENTILATING APPARATUS FOR RAILWAY EQUIPMENT

STEAM TRAPS—PRESSURE REGULATORS
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CHICAGO NEW YORK BOSTON
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MONTREAL

Dearborn Service

IS just as important an aid to economical railway operation in this time of reconstruction as during the most strenuous months of the war period.

The railways must use the best in every line of supplies, in order to maintain the standard of service required. Dearborn Water Treatment has proven its value and is now in use on more than 100 railways in the United States. A satisfied user is the best recommendation of the quality of the product.

Our organization of chemists and mechanical experts is at the service of the railways at all times in the solving of bad water problems.

Dearborn Chemical Co.
332 S. Michigan Avenue, Chicago

CAST STEEL

MAJOR COUPLERS
"D" COUPLERS
TRUCK FRAMES
TRUCK BOLSTERS
BODY BOLSTERS
DRAFT YOKES

THE BUCKEYE STEEL CASTINGS CO.
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CHICAGO 619 Ry. Exchange
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NEW YORK 50 Church St.

WITH
CRECO
THIRD POINT SUPPORT
CONSERVE YOUR BRAKE SHOES!
INSURE LONGER BRAKE SHOE WEAR BY GIVING THEM PROPER BRAKE BEAM SUPPORT.
THE CRECO BRAKE BEAM SUPPORT PREVENTS 80% OF THE PRESENT WASTE IN BRAKE SHOES. IT ALSO ELIMINATES THE NECESSITY OF USING SAFETY CHAINS OR ANY OTHER SAFETY-FIRST DEVICE ON THE BRAKE BEAM.
CHICAGO RAILWAY EQUIPMENT COMPANY.
McCORMICK BUILDING CHICAGO, ILL.
WITHOUT

"NEVERBREAK WALKOVER CARSEAT"

These three words tell the story of the H & K ALLSTEEL CARSEAT that made the STEEL PASSENGER CAR comfortable, and why it has been used in every first-class Steel Car since the original was built.

HALE AND KILBURN CORP.

NEW YORK PHILADELPHIA CHICAGO
DETROIT WASHINGTON LONDON

All kinds of Pressed or Drawn Metal Parts (light or medium), for Governmental, Railway or other purposes. Put your stamping problems up to us—headquarters for

"TRIPLE UTILITY STAMPINGS"

BRAKE SHOES

AMERICAN BRAKE SHOE & FOUNDRY COMPANY

30 Church St., New York

322 So. Michigan Ave., CHICAGO

Chattanooga, TENN.

Gold Medal Award, Panama-Pacific Exposition

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WANTED

MACHINISTS. Experienced men can earn good wages with splendid opportunities for advancement. Excellent shop conditions and permanent employment. Apply giving full particulars as to your experience, age, etc., to Box 32, Railway Mechanical Engineer, Woolworth Building, New York, N. Y.

LOCOMOTIVE VALVE SETTERS. First class experienced men. Good wages, excellent shop conditions, opportunities for advancement and permanent employment. Apply giving full particulars as to your experience, age, etc., to Box 33, Railway Mechanical Engineer, Woolworth Building, New York, N. Y.

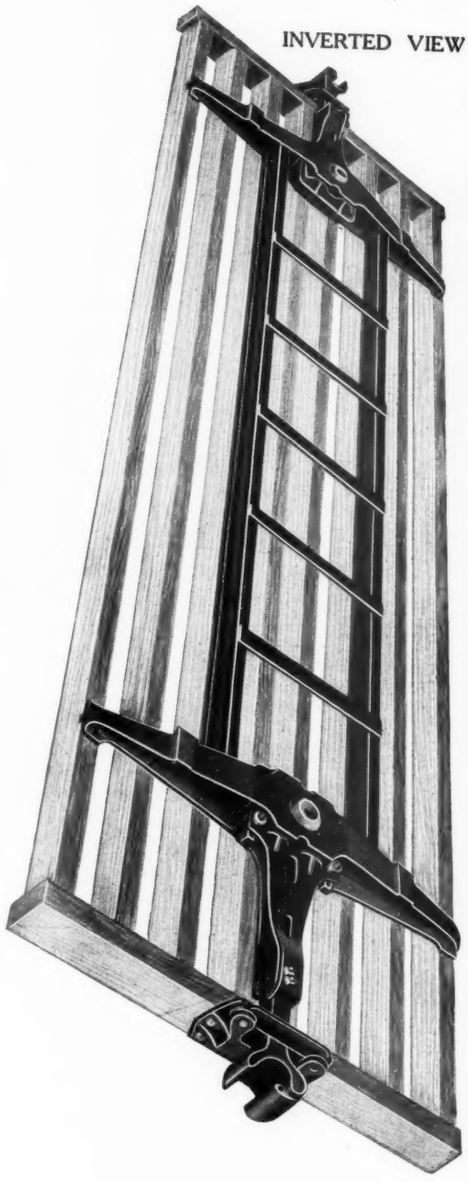
A classified advertising section will be incorporated in this publication whenever necessary.

Use this service when seeking a new man, a new position, or when buying or selling second-hand equipment.

Rate is 5c. a word a month. Minimum charge $1.00, Remittance must accompany each order. Address Railway Mechanical Engineer, Classified Advertising Department, Woolworth Building, New York, N. Y.

COMMONWEALTH
TRANSOM DRAFT GEAR
(PATENTED)

INVERTED VIEW



It is ideal for reinforcing old wooden cars

It pulls radially from the pivoting point of the car body on the truck

It insures a direct thrust or pull on a strong, firmly secured body bolster, which distributes all shocks to all the sills.

"DRAFT GEAR REPAIRS" ELIMINATED

Commonwealth Steel Company

Pierce Building **Saint Louis**

10

"CRANDALL REX"
Air Pump Packing

Style 140 AP

REX AIR PUMP PACKING is made of a plurality of braids of high grade asbestos yarn. Each strand is thoroughly impregnated by a vacuum and pressure process, with a high flash test and viscous lubricant. The separate strands being insulated with flake graphite before braiding, they cannot bond and fuse together under excessive heat and pressure. These features render the packing permanently soft and pliable.

We are putting up in metallic containers the packing of all sizes of Westinghouse or New York Air Pumps, also most sizes of locomotive throttle.

This is an innovation which strongly appeals to users of packing, in that it keeps the goods free from dirt, grit and foreign matter injurious to its giving best results. As the package is sealed it prevents deterioration and loss of lubrication.

CRANDALL PACKING CO.
PALMYRA, N. Y.

BRANCHES:

Boston	Pittsburgh	Chicago	New Orleans
New York	Birmingham	Cleveland	San Francisco

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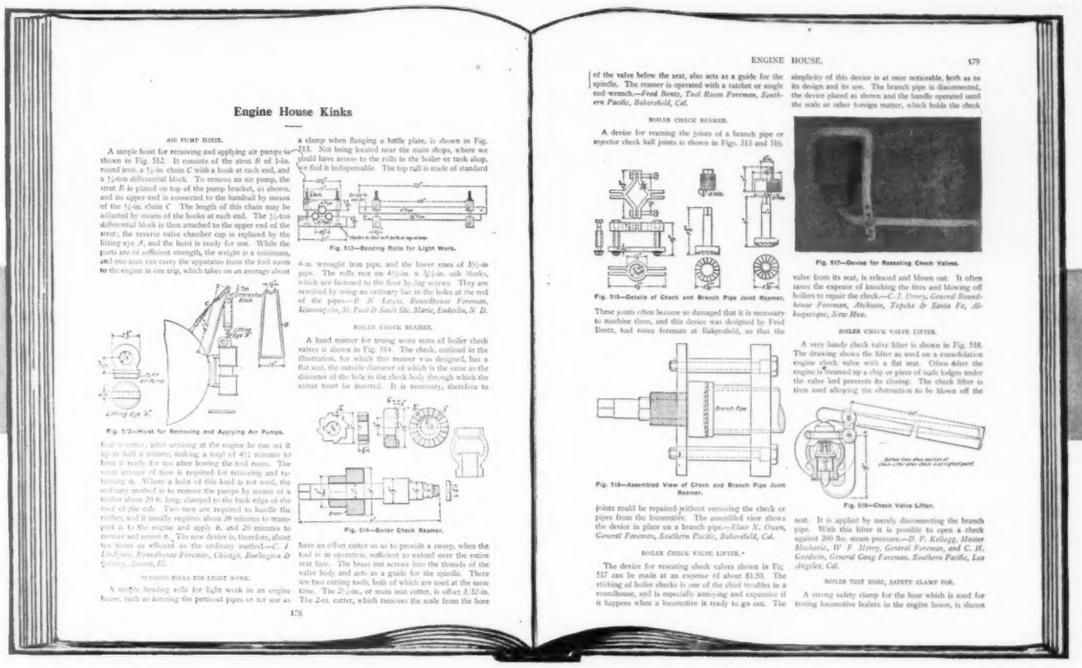

Engine House Kinks

AIR PUMP HOIST.

A simple hoist for removing and applying air pumps is shown in Fig. 512. It consists of the strut *B* of 14in. round iron, a ⅝-in. chain *C* with a hook at each end, and a ¾-ton differential block. To remove an air pump, the strut *B* is placed on top of the pump bracket, as shown, and its upper end is connected to the handrail by means of the ⅝-in. chain *C*. The length of this chain may be adjusted by means of the hooks at each end. The ¾-ton differential block is then attached to the upper end of the strut; the reverse valve chamber cap is replaced by the lifting eye *A*, and the hoist is ready for use. While the parts are of sufficient strength, the weight is a minimum, and one man can carry the apparatus from the tool room to the engine in one trip, which takes on an average about four minutes, after arriving at the engine he can set it up in half a minute, making a total of 4½ minutes to have it ready for use after leaving the tool room. The same amount of time is required for removing and returning it. Where a hoist of this kind is not used, the ordinary method is to remove the pumps by means of a timber about 20 ft. long, clamped to the back edge of the roof of the cab. Two men are required to handle the timber, and it usually requires about 38 minutes to transport it to the engine and apply it, and 20 minutes to remove and return it. The new device is, therefore, about two times as efficient as the ordinary method.—*C. J. Lindsey, Roundhouse Foreman, Chicago, Burlington & Quincy, Aurora, Ill.*

BENDING ROLLS FOR LIGHT WORK.

A simple bending rolls for light work in an engine house, such as forming the perticoat pipes or for use as a clamp when flanging a baffle plate, is shown in Fig. 513. Not being located near the main shops, where we could have access to the rolls in the boiler or tank shop, we find it indispensable. The top roll is made of standard

Fig. 513—Bending Rolls for Light Work.

4-in. wrought iron pipe, and the lower ones of 3½-in. pipe. The rolls rest on 4½-in. x 2½-in. oak blocks, which are fastened to the floor by lag screws. They are revolved by using an ordinary bar in the holes at the end of the pipes.—*B. N. Lewis, Roundhouse Foreman, Minneapolis, St. Paul & Sault Ste. Marie, Enderlin, N. D.*

BOILER CHECK REAMER.

A hand reamer for truing worn seats of boiler check valves is shown in Fig. 514. The check, outlined in the illustration, for which this reamer was designed, has a flat seat, the outside diameter of which is the same as the diameter of the hole in the check body through which the cutter must be inserted. It is necessary, therefore to

Fig. 514—Boiler Check Reamer.

have an offset cutter so as to provide a sweep, when the tool is in operation, sufficient to extend over the entire seat face. The brass rod screws into the threads of the valve body and acts as a guide for the spindle. There are two cutting tools, both of which are used at the same time. The 2⅛-in., or main seat cutter, is offset 3/32-in. The 2-in. cutter, which removes the scale from the bore

178

ENGINE HOUSE. 179

of the valve below the seat, also acts as a guide for the spindle. The reamer is operated with a ratchet or single end wrench.—*Fred Bentz, Tool Room Foreman, Southern Pacific, Bakersfield, Cal.*

BOILER CHECK REAMER.

A device for reaming the joints of a branch pipe or injector check ball joints is shown in Figs. 515 and 516.

Fig. 515—Details of Check and Branch Pipe Joint Reamer.

These joints often become so damaged that it is necessary to machine them, and this device was designed by Fred Dentz, tool room foreman at Bakersfield, so that the

Fig. 516—Assembled View of Check and Branch Pipe Joint Reamer.

joints could be repaired without removing the check or pipes from the locomotive. The assembled view shows the device in place on a branch pipe.—*Elias N. Owen, General Foreman, Southern Pacific, Bakersfield, Cal.*

BOILER CHECK VALVE LIFTER.

The device for reseating check valves shown in Fig. 517 can be made at an expense of about $1.50. The sticking of boiler checks is one of the chief troubles in a roundhouse, and is especially annoying and expensive if it happens when a locomotive is ready to go out. The

Fig. 517—Device for Reseating Check Valves.

valve from its seat, is released and blown out. It often saves the expense of knocking the fires and blowing off boilers to repair the check.—*C. J. Dorey, General Roundhouse Foreman, Atchison, Topeka & Santa Fe, Albuquerque, New Mex.*

BOILER CHECK VALVE LIFTER.

A very handy check valve lifter is shown in Fig. 518. The drawing shows the lifter as used on a consolidation engine check valve with a flat seat. Often after the engine is steamed up a chip or piece of scale lodges under the valve and prevents its closing. The check lifter is then used allowing the obstruction to be blown off the

Fig. 518—Check Valve Lifter.

seat. It is applied by merely disconnecting the branch pipe. With this lifter it is possible to open a check against 200 lbs. steam pressure.—*D. P. Kellogg, Master Mechanic, W. F. Merry, General Foreman, and C. H. Goodwin, General Gang Foreman, Southern Pacific, Los Angeles, Cal.*

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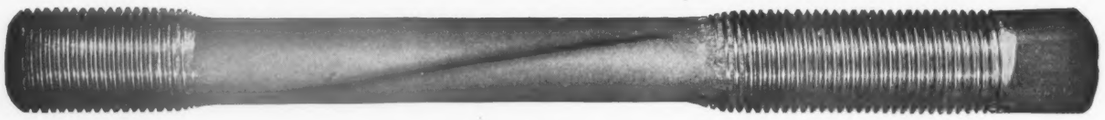

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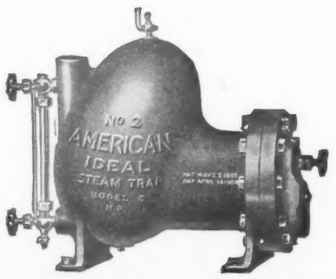

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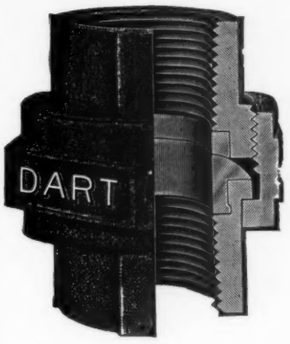

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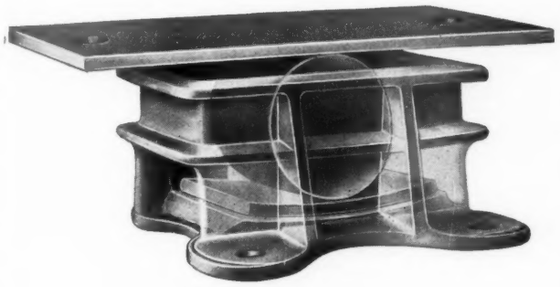

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Reed-Prentice Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Sherritt & Stoer Co., Inc.

DRILLING MACHINES (ARCH BAR).
Foote-Burt Co.
Niles-Bement-Pond Co.

DRILLING MACHINES, HEAVY DUTY.
Colburn Machine Tool Co.

DRILLING MACHINES, HORIZONTAL.
Foote-Burt Co.

DRILLING MACHINES, MULTIPLE.
Foote-Burt Co.
Niles-Bement-Pond Co.

DRILLING MACHINES, RADIAL.
American Tool Works Co.
Niles-Bement-Pond Co.
Reed-Prentice Co.
Rich Tool Co.

DRILLS, BENCH, SENSITIVE.
Wisconsin Electric Co.

DRILLS, HIGH DUTY.
Colburn Machine Tool Co.

DRILLS, HIGH SPEED.
The Aurora Tool Wks.

DRILLS, PORTABLE (ELECTRIC)
Chicago Pneumatic Tool Co.

DRILLS, PORTABLE (PNEUMATIC).
Chicago Pneumatic Tool Co.

DRILLS, ROCK.
Cleveland Twist Drill Co.
Ingersoll-Rand Co.

DRILLS, TWIST.
Cleveland Twist Drill Co.
Morse Twist Drill & Machine Co.
Ryerson & Son, Jos. T.

DRINKING FOUNTAINS.
Manufacturing Equip. & Eng. Co.

DRIVING WHEEL CENTERS.
American Steel Foundries.
Commonwealth Steel Co.

DUST GUARDS.
Symington Co., T. H.

DYNAMOS AND MOTORS.
General Electric Co.
Reliance Electric & Eng. Co.

ELECTRIC LIGHTING AND POWER.
General Electric Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC STEEL CASTINGS.
American Steel Foundries.

EMERY WHEELS.
Bridgeport Safety Emery Wheel Co.

ENGINES, CRUDE AND FUEL OIL.
Chicago Pneumatic Tool Co.

ENGINES, GAS AND GASOLINE.
Chicago Pneumatic Tool Co.

EXHAUST FANS AND HEADS.
General Electric Co.

EXPANDING MANDRELS.
Faessler Mfg. Co., J.
Nicholson & Co., W. H.

EYE BOLTS.
Williams & Co., J. H.

FACTORY GATES.
Page Steel & Wire Co.

FANS, ELECTRIC.
General Electric Co.
Westinghouse Electric & Mfg. Co.

FILE CLEANER.
Nicholson File Co.

FILES.
Nicholson File Co.

FILES, TOOL MAKING.
Nicholson File Co.

FIRE DOORS, LOCOMOTIVE.
Franklin Railway Supply Co., Inc.

FITTINGS, AIR BRAKE.
Steel Car Forge Co.
Westinghouse Air Brake Co.

FITTINGS, GAS-FIXTURE.
Dart Mfg. Co., E. M.

FIXTURES, LOCOMOTIVE FIRE DOOR.
Franklin Railway Supply Co., Inc.

FLANGES.
Dart Mfg. Co., E. M.

FLANGING CLAMPS.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.

FLANGING MACHINES.
Chambersburg Engineering Co.
Hilles & Jones Co.
McCabe Mfg. Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.

FLANGING PRESSES.
Niles-Bement-Pond Co.

FLANGING PRESSES, HYDRAULIC.
Chambersburg Engineering Co.

FLUE CLEANING MACHINES.
Ryerson & Son, Jos. T.

FLUE CUTTERS.
Faessler Mfg. Co., J.
Ryerson & Son, Jos. T.
Underwood Corp., H. B.

FLUE EXPANDERS.
Faessler Mfg. Co., J.
Ryerson & Son, Jos. T.

FLUE SHOP MACHINERY.
Ryerson & Son, Jos. T.

FORGES.
Bradley & Son, C. C.

FORGES, OIL RIVETS.
Ryerson & Son, Jos. T.

FORGING MACHINES.
Acme Machinery Co.
Ajax Manufacturing Co
Chambersburg Engineering Co.
National Machinery Co.
Sherritt & Stoer Co., Inc.

FORGING PRESSES, HYDRAULIC.
Chambersburg Engineering Co.

FORGINGS, CAR.
Steel Car Forge Co.

FOUNDRY FACINGS.
United States Graphite Co.

FOUNTAINS, SANITARY DRINKING.
Manufacturing Equipment & Engineering Co.

FRAMES, TRUCK.
Commonwealth Steel Co.

FRONT-END LUSTRE.
United States Graphite Co., The.

FUEL OILS.
Texas Company

FULCRUMS, BRAKE BEAM.
American Steel Foundries

FURNACES.
Brown & Sharpe Mfg. Co.
Railway Materials Co.

GAP LATHES.
Bridgeford Machine Tool Works.
Niles-Bement-Pond Co.

GAGES.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Brown & Sharpe Mfg. Co.
Greenfield Tap & Die Corp.

GAGES — HEIGHT, DEPTH, THREAD, THICKNESS—SCREW, ETC.
Greenfield Tap & Die Corp.
Starrett, The, L. S., Company.

GAGES, PRESSURE, GAS.
Air Reduction Sales Co.

GAGES, PRESSURE AND VACUUM.
Ashton Valve Co.

GAGES, STEAM.
American Steam Gauge & Valve Mfg. Co.

GAGES, WHEEL PRESS RECORDING.
Ashton Valve Co.

GALVANIZED WIRE.
Page Steel & Wire Co.

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Air Reduction Sales Co.

GASKETS.
Westinghouse Air Brake Co.

GASOLINE STORAGE SYSTEMS.
S. F. Bowser & Co., Inc.

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Gisholt Machine Co.

GEAR TURNING MACHINE, BEVEL.
Bridgeford Machine Tool Works.

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General Electric Co.

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Air Reduction Sales Co.

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Lincoln Electric Co.
Reliance Electric & Eng. Co.

GENERATORS, OXYGEN AND HYDROGEN.
International Oxygen Co.

GOGGLES.
Standard Optical Co.

GRAB IRONS.
Steel Car Forge Co.

GRAPHITE.
United States Graphite Co., The.

GRAPHITE, GRAPHITE PAINT.
Dixon Crucible Co., Joseph

GRAPHITE LUBRICATORS.
Gilbert & Sons Brass Fdy. Co., A.

GRAPHITE PIPE CEMENT.
United States Graphite Co., The.

GRATES.
Hulson Grate Co.

GRATE SHAKER.
Franklin Railway Supply Co., Inc.

GREASE.
U. S. Graphite Co., The.

GREASE MACHINE.
Franklin Railway Supply Co., Inc.

GRINDERS, CHASER.
Geometric Tool Co.
Landis Machine Company
Modern Tool Co.

GRINDERS, PORTABLE (ELECTRIC).
Chicago Pneumatic Tool Co.
Wisconsin Electric Co.

GRINDERS, PORTABLE (PNEUMATIC).
Chicago Pneumatic Tool Co.

GRINDERS, UNIVERSAL.
Greenfield Tap & Die Corp.

GRINDING MACHINES.
Becker Milling Machine Co.
Brown & Sharpe Mfg. Co.
Diamond Machine Co.
Heald Machine Co.
Modern Tool Co.
Niles-Bement-Pond Co.
Norton Company
Norton Grinding Co.
Sherritt & Stoer Co., Inc.
Wisconsin Electric Co.

GRINDING MACHINES, CYLINDER.
Heald Machine Co., The.

GRINDING MACHINES, DISC.
Diamond Machine Co.

GRINDING MACHINES, INTERNAL.
Heald Machine Co., The.

GRINDING MACHINE TOOL.
Gisholt Machine Co.

GRINDING WHEELS.
Norton Co.

GROUND RODS.
Page Steel & Wire Co.

GUY WIRES.
Page Steel & Wire Co.

HACK SAWS.
E. C. Atkins & Co., Inc.
Starrett, The L. S., Co.
Victor Saw Wks.

HACK SAW MACHINES, POWER.
E. C. Atkins & Co., Inc.
Starrett Co., The, L. S.

HAMMERS, BELT AND MOTOR DRIVEN.
Bradley & Sons, C. C.
United Hammer Co.

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Chambersburg Engineering Co.
Erie Foundry Co.
Niles-Bement-Pond Co.

HAMMERS, HELVE.
Bradley & Son, C. C.

HAMMERS, PNEUMATIC.
Sellers & Co., Inc., Wm.

HAMMERS, POWER DROP.
Bradley & Co., C. C.
Chambersburg Engineering Co.
Ryerson & Son, Jos. T.
United Hammer Co.

HAMMERS, RIVETING.
Chicago Pneumatic Tool Co.

HAMMERS, STEAM DROP.
Chambersburg Engineering Co.
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Morse Chain Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Yale & Towne Mfg. Co.

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Ford Chain, Block & Mfg. Co.
Yale & Towne Mfg. Co.

HOOKS, HOIST AND CAR.
Williams & Co., J. H.

HOSE, AIR BRAKE.
Westinghouse Air Brake Co.

HOSE, AIR, STEAM, ETC.
Chicago Pneumatic Tool Co.
Westinghouse Air Brake Co.

HOTBOX COMPOUND.
Gill Railway Supply Co.

HOSE COUPLINGS.
Westinghouse Air Brake Co.

HYDRAULIC MACHINES.
Chambersburg Engineering Co.
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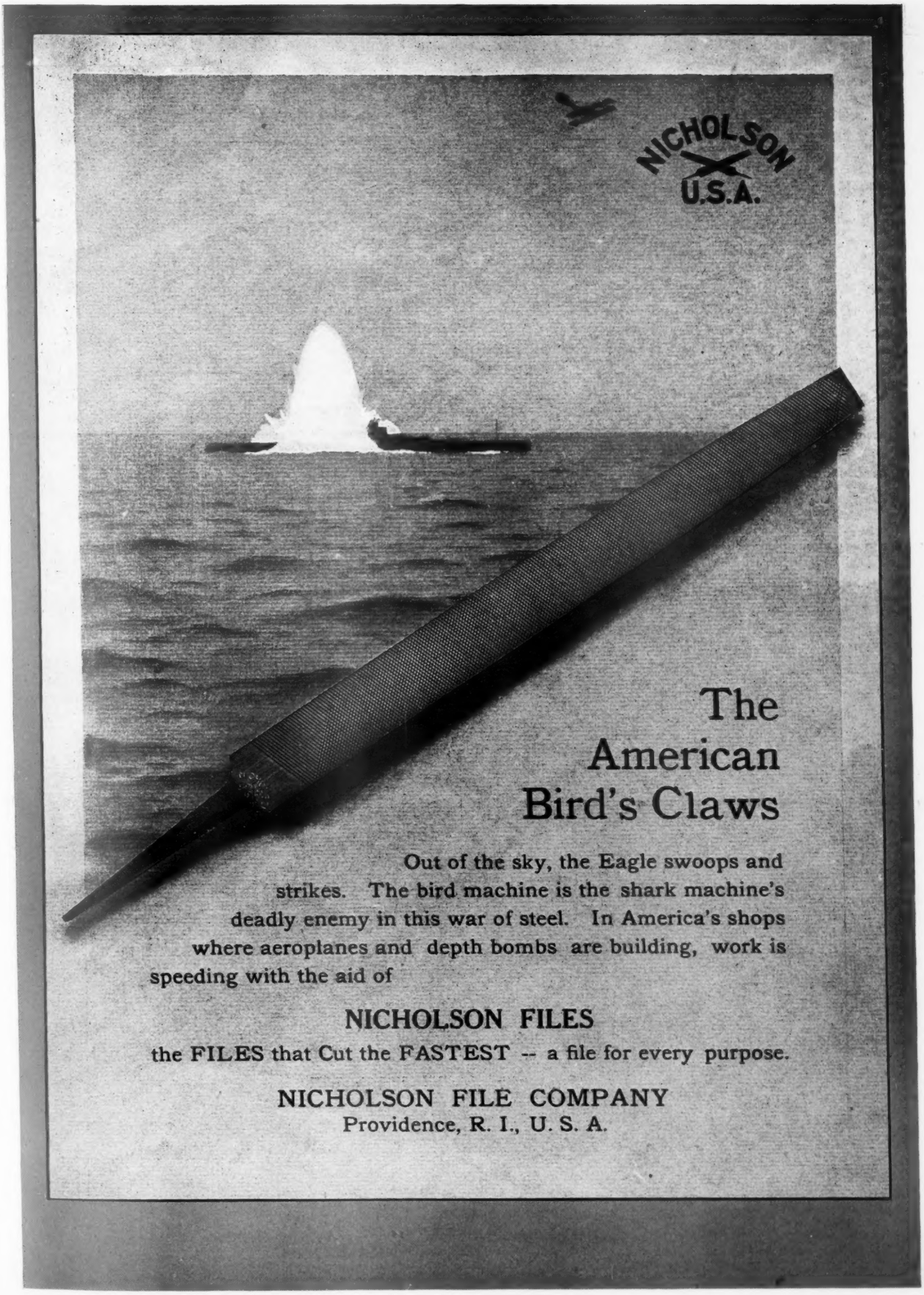
Watson-Stillman Co.

HYDROGEN.
Air Reduction Sales Co.
International Oxygen Co.

INJECTORS.
Sellers & Co., Inc., Wm.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Out of the sky, the Eagle swoops and strikes. The bird machine is the shark machine's deadly enemy in this war of steel. In America's shops where aeroplanes and depth bombs are building, work is speeding with the aid of
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BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers' Index, see Alphabetical Index on the last page next to cover

INSULATING MATERIALS.
General Electric Co.

INTENSIFIERS, HYDRAULIC.
Chambersburg Engineering Co.

IRON CEMENT.
Smooth-On Mfg. Co.

IRON FENCING.
Page Steel & Wire Co.

JACKS.
Duff Mfg. Co.

JACKS, HYDRAULIC.
Watson-Stillman Co.

JIGS AND FIXTURES.
Gisholt Machine Co.

JOINTS, FLEXIBLE BALL.
Barco Mfg. Co.

JOINTS, FLEXIBLE FOR ENGINE TENDER CONNECTIONS.
Barco Mfg. Co.

JOINTS, STEAM, LIQUID AIR.
Barco Mfg. Co.
Franklin Railway Supply Co., Inc.

JOINTS, SWING.
Barco Mfg. Co.
Franklin Railway Supply Co., Inc.

JOURNAL BOXES AND LIDS.
Allegheny Steel Co.
Gould Coupler Co.
National Malleable Castings Co.
Symington Co., T. H.

JOURNAL BOX WEDGES.
Steel Car Forge Co.

KEY-WAY CUTTERS (PORTABLE AND STATIONARY).
Morton Mfg. Co.

KNUCKLE PINS.
Steel Car Forge Co.

LAMPS, INCANDESCENT.
General Electric Co.
Westinghouse Electric & Mfg. Co.

LATHE DOGS.
Armstrong Bros. Tool Co.

LATHE TOOLS.
Armstrong Bros. Tool Co.
Williams & Co., J. H.

LATHE TOOL CABINETS.
Armstrong Bros. Tool Co.

LATHES.
American Tool Works Co.
Barber Coleman Co.
Bardons & Oliver
Bridgeford Machine Tool Works.
Bullard Machine Tool Co.
Duff Mfg. Co.
Greaves-Klusman Tool Co.
National Lathe Co., The.
Niles-Bement-Pond Co.
Reed Prentice Co.
Rockford Tool Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Seneca Falls Mfg. Co.
Sherritt & Stoer Co., Inc.
Warner & Swasey Co.

LATHES, AUTOMATIC.
Jones & Lamson Machine Co.

LATHES, AUTOMATIC AND SEMI-AUTOMATIC.
Gisholt Machine Co.

LATHES, AXLE.
Bridgeford Machine Tool Works.
Niles-Bement-Pond Co.
Sherritt & Stoer Co., Inc.

LATHES, BRASS WORKERS.
Bardons & Oliver Co.
Niles-Bement-Pond Co.
Reed-Prentice Co.

LATHES, CAR WHEEL.
Niles-Bement-Pond Co.

LATHES, DRIVING WHEEL.
Niles-Bement-Pond Co.

LATHES, ENGINE.
American Tool Works Co.
Bridgeford Machine Tool Works Co.
Gisholt Machine Co.
Greaves-Klusman Tool Co.
Reed-Prentice Co.
Ryerson & Son, Jos. T.

LATHES, ENGINE (HEAVY).
American Tool Works Co.
Bridgeford Machine Tool Works
Niles-Bement-Pond Co.

LATHES, GEARED HEAD.
American Tool Works Co.
Bridgeford Machine Tool Works.
Niles-Bement-Pond Co.
Reed-Prentice Co.

LATHES, HORIZONTAL TURRET.
Gisholt Machine Co.

LATHES, JOURNAL TRUING.
Bridgeford Machine Tool Works.
Niles-Bement-Pond Co.

LATHE TOOLS.
Armstrong Bros. Tool Co.
Gisholt Machine Co.

LATHES, TURRET.
Acme Machine Tool Co.
Bardons & Oliver
Bridgeport Machine Tool Works.
International Machine Tool Co.
Jones & Lamson Machine Co.
Sellers & Co., Inc., Wm.
Warner & Swasey Co.

LEGS, BENCH.
Manufacturing Equip. & Eng. Co.

LIGHTING, CAR.
General Electric Co.
Gould Coupler Co.

LOCK NUTS.
Columbia Nut & Bolt Co., Inc.

LOCKERS, METAL.
Manufacturing Equip. & Eng. Co.

LOCK NUTS.
Columbia Nut & Bolt Co., Inc.
Franklin Railway Supply Co., Inc.

LOCOMOTIVES.
American Locomotive Co.
Baldwin Locomotive Works, The

LOCOMOTIVE FRAME DRILLING MACHINES.
Niles-Bement-Pond Co.

LOCOMOTIVE GRATES.
Hulson Grate Co.

LOCOMOTIVE GUIDE LINERS.
Starrett Co., L. S.

LOCOMOTIVE HEADLIGHT WIRE.
Habirshaw Electric Cable Co., Inc.

LOCOMOTIVE POP VALVES.
American Steam Gauge & Valve Mfg. Co.

LOCOMOTIVE REPAIR EQUIPMENT.
Rooksby & Co., E. J.
Ryerson & Son, Jos. T.
Underwood & Corp., H. B.

LOCOMOTIVE TOOLS.
Williams & Co., J. H.

LOCOMOTIVES, COMPRESSED AIR.
Baldwin Locomotive Works.

LOCOMOTIVES, CONTRACTORS'.
Lima Locomotive Works, Inc.

LOCOMOTIVES, ELECTRIC.
American Locomotive Co.
Baldwin Locomotive Works
General Electric Co.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVES, GEARED.
Lima Locomotive Works, Inc.

LOCOMOTIVES, MINE.
Baldwin Locomotive Works.
General Electric Co.

LOCOMOTIVES, STEAM.
Lima Locomotive Works, Inc.

LUBRICANTS.
Dixon Crucible Co.
Texas Co., The.
United States Graphite Co., The.

LUBRICATING GRAPHITE.
United States Graphite Co., The.

LUBRICANTS, OILS & GREASES.
Texas Company, The.

LUBRICATORS.
Detroit Lubricator Co.
Franklin Railway Supply Co., Inc.
United States Graphite Co., The.

LUBRICATORS, LOCOMOTIVE, STEAM ENGINE, FLANGE, AIR CYLINDER.
United States Graphite Co., The.

MACHINE GUARDS.
Page Steel & Wire Co.

MACHINERY, GAS PRODUCERS'.
Air Reduction Sales Co.

MEASURING DEVICES FOR OILS.
S. F. Bowser & Co., Inc.

METAL CLEANER.
J. D. Ford Co., The

METALLURGICAL PROCESSES.
Metal & Thermit Corp.

MICROMETERS.
Brown & Sharpe Mfg. Co.
Starrett Co., The, L. S.

MILLING CUTTERS.
Barber Coleman Co.
Becker Milling Machine Co.
Brown & Sharpe Mfg. Co.

MILLING MACHINES.
Becker Milling Machine Co.
Betts Machine Co.
Bickett Machine & Mfg. Co.
Brown & Sharpe Mfg. Co.
Gisholt Machine Co.
Landis Tool Co.
Newton Machine Tool Works
Niles-Bement-Pond Co.
Rooksby & Co., E. J.
Underwood Corp., H. B.

MINING MACHINERY.
Lima Locomotive Works, Inc.

MOTORS, ELECTRIC.
General Electric Co.
Lincoln Electric Co.
Reliance Electric & Eng. Co.
Westinghouse Electric & Mfg. Co.

MULTIPLE DRILLS.
Foote-Burt Co.
Niles-Bement-Pond Co.

NAILS, COPPER COVERED.
Page Steel & Wire Co.

NIPPLE THREADING MACHINES.
Landis Machine Co., Inc.

NITROGEN.
Air Reduction Sales Co.

NUTS.
Ryerson & Son, Jos. T.
Steel Car Forge Co.

OIL CUPS
Detroit Lubricator Co.
United States Metallic Packing Co.

OIL FILTERING AND CLARIFYING SYSTEMS.
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OIL PUMPS (HAND AND POWER).
S. F. Bowser & Co., Inc.

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S. F. Bowser & Co., Inc.

OILERS, FLANGE.
Detroit Lubricator Co.

OILS.
Galena-Signal Oil Co.
Texas Company, The.

OUTFITS, WELDING.
Air Reduction Sales Co.

OXY-ACETYLENE APPARATUS.
International Oxygen Co.

OXYGEN.
Air Reduction Sales Co.
International Oxygen Co.

PACKING.
Crandall Packing Co.
United States Metallic Packing Co.

PACKING, STEAM.
Crandall Packing Co.

PAINT GRAPHITE.
United States Graphite Co., The.

PARTITIONS, WOVEN STEEL.
Page Steel & Wire Co.

PEDESTAL FACERS.
Underwood Corp., H. B.

PINS, KNUCKLE.
Steel Car Forge Co.

PIPE.
A. M. Byers Co.
National Tube Co.

PIPE AND NIPPLE THREADING MACHINES.
Landis Machine Company.

PIPE THREADING AND CUTTING-OFF MACHINERY.
Greenfield Tap & Die Corporation.
Landis Machine Co., Inc.
Niles-Bement-Pond Co.

PIPE WRENCHES.
Williams & Co., J. H.

PIPE (WROUGHT IRON).
A. M. Byers Co.

PLANERS.
Betts Machine Co.
Bickett Machine & Mfg. Co.
Cincinnati Planer Co.
Hamilton Machine Tool Wks.
Morton Mfg. Co.
Newton Machine Tool Works.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

PLANERS, PLATE.
Niles-Bement-Pond Co.

PLANERS, VALVE SEAT.
Rooksby & Co., E. J.
Underwood Corp., H. B.

PLANER TOOLS.
Armstrong Bros. Tool Co.

PLANING ATTACHMENTS, RADIUS.
Underwood Corp., H. B.

PLANING MACHINES.
American Tool Works Co.
Betts Machine Co.
Bickett Machine & Mfg. Co.
Niles-Bement-Pond Co.
Underwood Corp., H. B.

PLANTS, WELDING, CUTTING.
Air Reduction Sales Co.

PLATFORMS, CAR.
Commonwealth Steel Co.

PLATES, BOILER, FIREBOX, Etc.
Lukens Steel Co.
Ryerson & Son, Jos. T.

PLATES, STEEL.
Ryerson & Son, Jos. T.

PLUGS, STEAM CHEST OIL.
Franklin Railway Supply Co., Inc.

PLUMBAGO.
United States Graphite Co.

PNEUMATIC TOOLS.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

POINTING MACHINES, BOLT.
Landis Machine Co., Inc.

POLISHING MACHINES.
Brown & Sharpe Mfg. Co.
Diamond Machine Co.

PORTABLE TOOLS.
Rooksby & Co., E. J.
Underwood Corp., H. B.

POWER REVERSE GEARS.
Commonwealth Supply Co.

PRESSES, CRANK PIN.
Watson-Stillman Co.

PRESSES, HYDRAULIC.
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
Watson-Stillman Co.

PRESSES, POWER, FORCING.
Chambersburg Engineering Co.
Erie Foundry Co.
Lucas Machine Tool Co.
Ryerson & Son, Jos. T.

PRESSES, TRIMMING.
Erie Foundry Co.

PRODUCERS' GAS.
Air Reduction Sales Co.

PULLEY HANGERS, SAFETY.
Armstrong Bros. Tool Co.

PULLEYS.
Brown & Sharpe Mfg. Co.

PUMPS.
Brown & Sharpe Mfg. Co.

PUMPS, HYDRAULIC.
Chambersburg Engineering Co.
Watson-Stillman Co.

PUMPS & PUMPING MACHINERY.
Chambersburg Engineering Co.
Ingersoll-Rand Co.

PUNCHES.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Thomas Spacing Machine Co.
Wickes Bros.

PUNCHING AND SHEARING MACHINES.
Chambersburg Engineering Co.
Hilles & Jones Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.

RACKS, STORAGE STOCK.
Manufacturing Equip. & Eng. Co.

RARE GASES.
Air Reduction Sales Co.

RASPS.
Nicholson File Co.

RATCHET DRILLS.
Armstrong Bros. Tool Co.

REAMERS, ADJUSTABLE, BRONZE, CYLINDER, CONNECTING ROD AND LINE.
Chicago Pneumatic Tool Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Ryerson & Son, Jos. T.

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Gisholt Machine Co.

REAMERS, HIGH SPEED BRIDGE.
Rich Tool Co.

RECORDERS, TIME.
Gisholt Machine Co.

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Ajax Manufacturing Co.

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Air Reduction Sales Co.

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Graphite—if of the right sort—will enter into and fill up the tiny crevices and irregularities of the bearings and give them a perfectly smooth and almost frictionless surface.

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Graphite Fire Box Paint
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Waterproof Graphite Grease
Graphite Center Plate Lubricant
Motor and Generator Brushes

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SAN FRANCISCO - ST. LOUIS
MINES IN SONORA - MEXICO

BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers' Index, see Alphabetical Index on the last page next to cover

RIVETERS, HYDRAULIC.
Chambersburg Engineering Co.
RIVETING MACHINES.
Allen Co., John F.
Chambersburg Engineering Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
RIVETS.
Ryerson & Son, Jos. T.
Steel Car Forge Co.
RODS.
Page Steel & Wire Co.
RODS AND WIRE, WELDING.
Page Steel & Wire Co.
RODS, WELDING.
Air Reduction Sales Co.
ROLLER TUBE EXPANDERS.
Nicholson & Co., W. H.
ROLLS, RECLAIMING.
Ajax Manufacturing Co.
ROOF PAINT.
United States Graphite Co., The.
ROUNDHOUSE BLOWER LINE JOINTS.
Barco Mfg. Co.
ROUNDHOUSE BLOW OFF LINE JOINTS.
Barco Mfg. Co.
RULES—SCALES.
Starrett Co., L. S.
SAFE ENDS.
National Tube Co.
Ryerson & Son, Jos. T.
SAFETY GOGGLES.
Standard Optical Co.
SANDERS, LOCOMOTIVE TRACK
United States Metallic Packing Co.
SAWING MACHINES, COLD METAL.
E. C. Atkins & Co., Inc.
Greenfield Tap & Die Corp.
SAWS, HACK.
E. C. Atkins & Co., Inc.
SAWS (FOR METAL).
E. C. Atkins & Co., Inc.
Greenfield Tap & Die Corp.
SAW SHARPENING MACHINES (METAL).
Greenfield Tap & Die Corp.
SCREW MACHINES.
Brown & Sharpe Mfg. Co.
Foster Machine Co.
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Ryerson & Son, Jos. T.
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WHEELS, CAR.
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Carnegie Steel Co.
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ALPHABETICAL INDEX TO ADVERTISEMENTS

A

Acme Machinery Co., The 14
Acme Machine Tool Co., The 62
Air Reduction Sales Co 60
Ajax Mfg. Co., The 27
Allegheny Steel Co 109
Allen Co., John F 79
American Arch Co 85
American Brake Shoe & Foundry Co 112
American Flexible Bolt Co 114
American Locomotive Co 89
American Pulley Co ..... —
American Steam Gauge & Valve Mfg. Co. 114
American Steel Foundries 105
American Tool Works Co., The 5
Armstrong Bros. Tool Co 3
Ashton Valve Co., The 113a
Atkins & Co., Inc., E. C...Outside Back Cover
Atlas Crucible Steel Co 71
Aurora Tool Works, The 10

B

Baldwin Locomotive Works, The 87
Barber-Colman Co. 3
Barco Manufacturing Co 102
Bardons & Oliver 66
*Beaudry & Co., Inc ..... —
Becker Milling Machine Co 69
Betts Machine Co 6, 7
Bickett Machine & Mfg. Co., The ..... —
Bowser & Co., S. F., Inc 75
Bradley & Son, Inc., C. C 26
Breakless Staybolt Co., The 106
Bridgeford-Machine Tool Works 4
Bridgeport Safety Emery Wheel Co 33
Brown & Sharpe Mfg. Co 9
Brubaker & Bros., W. L 49
Buckeye Steel Castings Co., The 111
Bullard Machine Tool Co 18, 19
Buyers' Index 116, 118, 119, 120, 122
Byers Co., A. M 107

C

Canton Foundry & Machine Co 78
Carnegie Steel Co 71
Chambersburg Engineering Co 75
Chicago Pneumatic Tool Co 78
Chicago Railway Equipment Co 112
Cincinnati Planer Co 63
Cincinnati Shaper Co., The 39
Clark Equipment Co 12
Classified Advts. 112
Cleveland Twist Drill Co., The 46
Coes Wrench Co 73
Colburn Machine Tool Co 34, 35
Colonial Steel Co 54
Columbia Nut & Bolt Co., Inc 100
Commonwealth Steel Co 113
Crandall Packing Co 113

D

Dart Mfg. Co., E. M 115
Davis Boring Tool Co., Inc 11
Dearborn Chemical Co 111
Detroit Lubricator Co 108
Diamond Machine Co 66
Dixon Crucible Co., Joseph 98
Duff Mfg. Co., The 79
Durbin Co., The ..... —

E

Electric Arc Cutting & Welding Co 80
Electric Storage Battery Co., The 114
Erie Foundry Co 79

F

Faessler Mfg. Co., J 77
Firth-Sterling Steel Co 52
Flannery Bolt Co 108
Foote-Burt Co., The 23
Ford Chain Block & Mfg. Co 72
Ford Co., J. B., The 113a
Foster Machine Co 24
Franklin Railway Supply Co., Inc 84

G

Galena-Signal Oil Co 110
Garratt-Callahan Co. 91
General Electric Co 81
Geometric Tool Co., The 43
Gibson-Pribble & Co 76
Gilbert & Sons Brass Foundry Co., A 94
Gill Railway Supply Co 110
Gisholt Machine Co 28, 29
Globe Ventilator Co 113a
Gould Coupler Co 115
Greaves-Klusman Tool Co., The 62
Greenfield Tap & Die Corp 47, 61

H

Habirshaw Electric Cable Co., Inc 128
Hale & Kilburn Corporation 112
Hamilton Machine Tool Co 20
Heald Machine Co., The 32
Hilles & Jones Co 79
Hulson Grate Co 95

I

Ingersoll-Rand Co 70
International Machine Tool Co 25
International Oxygen Co 80

J

Jessop & Sons, Inc., Wm 76
Joliet Ry. Supply Co ..... —
Jones & Lamson Machine Co 70

L

Lagonda Mfg. Co., The 109
Landis Machine Co 74
Landis Tool Co 37
Lima Locomotive Works, Inc 86
Lincoln Electric Co., The 58
Locomotive Appliance Co ..... —
Locomotive Finished Material Co ..... —
Locomotive Stoker Co 92
Locomotive Superheater Co., The 83
Lucas Machine Tool Co 21
Lukens Steel Co 88

M

Manufacturing Equipment & Engrg. Co 78
McCabe Mfg. Co 36
McConway & Torley Co., The 106
Metal & Thermit Corp 80
Milwaukee Tank Works 104
Modern Tool Co 45
*Morse Chain Co 17
Morse Twist Drill & Machine Co 66
Morton Mfg. Co 15

N

National Lathe Co., The 64
National Machinery Co., The 77
National Malleable Castings Co., The 103
National Tube Co 96, 97
Newton Machine Tool Works, Inc 13
Nicholson & Co., W. H 78
Nicholson File Co 119
Niles-Bement-Pond Co. 8
Norton Co. 31
Norton Grinding Co 30

O

Onondaga Steel Co., Inc 64

P

Page Steel & Wire Co 59
Pantasote Co., The 117

Q

Q & C Co 124
Quigley Furnace Specialties Co., Inc 51

R

Railway Materials Co., The 114
Railway Utility Co 111
Reed-Prentice Co. 38
Reliance Electric & Engineering Co 56
Rice Mfg. Co ..... —
Rich Tool Co 53
Rickert-Shafer Co 44
Rockford Drilling Machine Co 74
Rockford Tool Co 2
Rooksby & Co., E. J 75
Roto Co., The 76
Ryerson & Son, Jos. T 82

S

Schroeder Headlight & Generator Co 101
Seaton Foundry Co., The John ..... —
Sellers & Co., Inc., Wm 2
Seneca Falls Mfg. Co., Inc., The 69
Sherritt & Stoer Co., Inc 67
Simplex Railway Appliance Co 105
Smooth-On Mfg. Co 65
Standard Optical Co 50
Starrett Co., The L. S 48
Steel Car Forge Co 115
Steinle Turret Machine Co 22
Steptoe Co., The John 3
Stucki Company, A 115
Symington Co., T. H 1

T

Texas Co., The 99
Thomas Spacing Machine Co 80

U

Underwood Corp., H. B 40
Union Draft Gear Co 123
*United Hammer Co 77
United States Graphite Co., The 121
United States Metallic Packing Co., The 90

V

Vanadium-Alloys Steel Co 55
Vapor Car Heating Co., Inc 111
Victor Saw Works 61

W

Warner & Swasey Co., The 16
*Watson-Stillman Co., The 41
Westinghouse Air Brake Co 93
Westinghouse Elec. & Mfg. Co 57
Whiting-Adams Co., John L. & J. J 76
Wickes Bros. 74
Williams & Co., J. H 72
Wisconsin Electric Co 42

Y

Yale & Towne Mfg. Co., The 73

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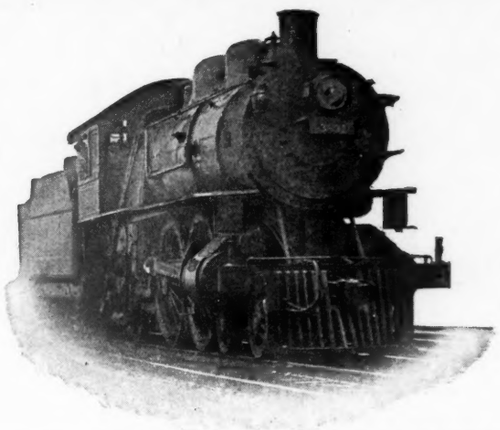

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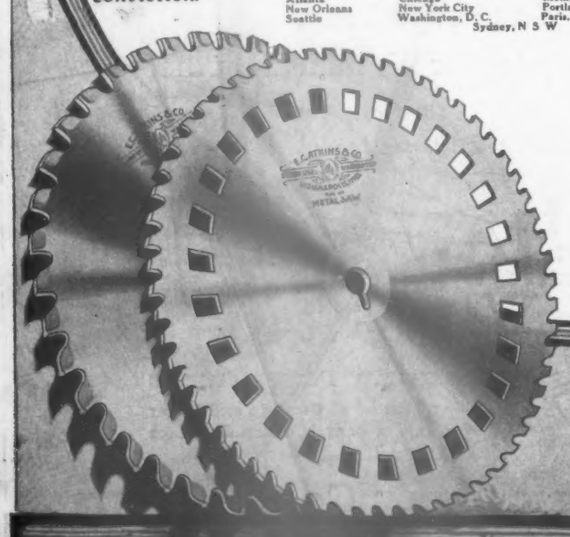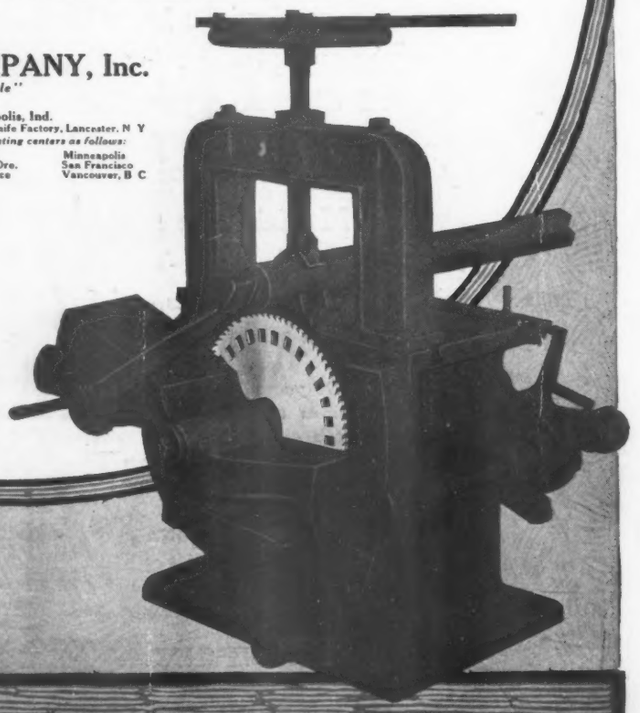
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